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Forthcoming Event.

SEPTEMBER 27—OCTOBER 1.

International Foundrymen's Congress and Exhibition at Detroit, U.S.A.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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A Necessary Step.

The ironfoundry industry has now arrived at the position where it can guarantee roughly double the mechanical tests of twenty-five years ago. In tensile 18 tons can be guaranteed on the thinner sections. Undoubtedly this fact is not realised by the majority of designers of importance. Again, associated truisms relative to the increased strength of thinner sections, containing, as they usually do, higher combined carbon as against thicker sections with higher and coarser graphitic structure, are but little appreciated. Other desiderata unrealised are the properties of a number of special grey irons. The question of paramount importance to the ironfoundry industry, taken as a whole, resolves itself into one of publicity as to the potentialities of their products. It is a matter for profound regret that the commercial organisations connected with the industry have not so far seen their way clear to take up this and allied matters energetically. Mr. R. O. Patterson, in his Presidential address delivered two years ago, showed a number of avenues which could be profitably opened up to ironfounders by co-operative action.

We are aware of the excellent work accomplished by both the national and district employers' federations, but are also cognisant of the limitations placed upon their work by the excessive number of concerns who see no value in co-operation. The excuses put forward to us range from a plea, that the firm is primarily engaged in engine building to one of that the majority of co-operating firms are not competitors! It was recently stated to us that the foundry industry was in an exactly similar financial condition to that of coal mining. The latter unfortunate industry does at least know where it stands in this respect.

It is an interesting speculation to imagine what character a Royal Commission Report would assume if one was formed to deliberate on ironfounding—an industry of an equally "key" character.

However, we do not believe that the industry is in such a poor condition, and the less Government interference it receives the better. As an industry, it suffers very severely from ridiculous price cutting, especially in certain types of castings such as street and railway castings. The manufacturers of these would certainly benefit from a national organisation, which would be in a position to enforce the limitation of the number of types of gulley grates and manhole covers to the minimum, and tackle their production of modern lines in such a manner that their cost would be no greater than that now prevailing but would yield a reasonable profit to the industry. The general public has always had grave fears of the institution of rings in industries. These are often groundless, because if prices are stabilised, then they are in a position to buy on quality alone. So far as the employee is concerned, he is usually in better position financially if cut-throat competition is voluntarily removed. As a member of the general public we do not object to manufacturing rings, but would be loud in protesting against rings of merchants—an unfortunate parasitic rider. So far as the foundry industry is concerned, there is room for many more organisations, in order that founders can assure for themselves a profit which will enable them to pay an adequate wage to their employees, and to equip themselves with machinery commensurate with modern developments. This is necessary in order to compete with countries possessing the doubtful and transitory advantage of depreciated currency.

The Application of Payment by Results to the Foundry Industry

By J. W. Kearsey.

The advantages accruing from the application of methods of payment by results are so well known and universally accepted that no eulogy of the derived benefits is necessary. Yet notwithstanding, the adoption of this principle of labour remuneration is carried out by relatively few firms in the foundry industry. That there are some deep-rooted reasons for this anomaly, fallacious or otherwise, will be obvious.

To obtain a clear view of payment by results one must first examine the principles and practical operation of the various methods, all of which can be included under two main groups, viz., collective and individual.

Collective bonus schemes are based on the principle of determining the rate payable to the individual by the gross results. The method is to classify all types and kinds of the output, and to total periodically upon some suitable measurement of volume. A standard periodic output is fixed, and bonus will be allowed on all production in excess of this amount. The standard output will be subjected to revision accordingly as conditions of production, number of employees, etc., vary. Bonus is paid to each employee at the rate of increase of output over standard, the share drawn by the individual varying according to his grade, status, etc. The total bonus will usually be calculated from some definite formula, which takes into consideration as far as possible the various contingencies which are likely appreciably to affect and unbalance the periodical bonus available for distribution.

Collective bonus schemes suffer from the severe handicap that individual skill and industry are not sufficiently rewarded. An essential incentive to increase individual production is that each man must receive the benefit of his own efforts to induce him to work at his maximum efficiency. The psychological result of pooling bonus seems adversely to affect the output of the best workers and to reduce their individual production to the level of the slowest man. A further disadvantage is the difficulty of arriving at a method of calculation that will obviate large periodic fluctuations in the bonus payable by taking into account all variable factors which influence the amount of output. It is extremely difficult to derive a formula that will guarantee a steady bonus payment, avoiding both periods of excessive earnings, due to some variation in methods or kind of output, and periods of no bonus payments, due to difficulties arising in production which keep output low and over which the men have no control.

In any scheme of individual bonus the earnings of each employee will be dependent upon his own efforts. He will be allowed a definite time or price for each task performed, and he will, either alone or in partnership with the firm, receive the benefit of any additional effort resulting in increased production. The bonus remuneration of each employee is entirely dependent on his own individual efforts. Individual bonus schemes resolve themselves principally into two classes, viz., piecework and premium bonus. The difference lies only in the methods of setting standards and calculating earnings. In piecework a price is fixed for each unit of output or operation, and payments worked out from this basis. In premium bonus a time standard is set for each task, and bonus is paid according to the amount of time saved, the method of calculation varying with the many different plans that can be adopted. A very important difference between premium bonus and piecework is that in the former system the saving is shared with the employer, while in the latter the whole amount is received by the employee. Yet this difference is in many ways more apparent than real, for piecework rates are far more stringent than premium bonus times, and the employee will frequently receive larger remuneration at premium bonus rates, even though the employer participates in the saving, than at piecework rates in return for same output of work.

Individual bonus schemes, operated fairly and efficiently, tend to secure the maximum production, but are subject to the disadvantage that it is extremely difficult to operate them for all trades and classes of labour included in the personnel of a works. This adverse circumstance is very serious, for the fact that some workers are on bonus and in a position considerably to increase their earnings above basic rates while others are not working under payment by results and therefore earn ordinary time rates only, will militate against smooth co-operation between the various grades of labour, tending to cause dissatisfaction, friction and inefficiency.

From the preceding remarks it will be apparent that any ideal method of payment by results will entail the existence of two essential conditions, viz.:—

1. That each worker shall, as far as possible, have his bonus payment computed according to the work that he individually has performed over and above a certain standard that shall be fixed for this purpose.

2. That the application of the general scheme must be on a basis whereby all grades of employees, from foreman downwards, can participate in the bonus remuneration.

To secure these conditions it will be impossible to apply similar methods to all trades and grades. Consequently one must examine each individually and decide suitable means whereby the obstacles appertaining to each in particular can be overcome. With this idea in mind it is proposed to review the various classes of labour, included in the personnel of a foundry, in rotation.

Pattern Making.

Payment by results has not had any appreciable application to this craft, owing to the existence of rate-fixing difficulties that are supposedly of an insuperable nature. Some large works with extensive pattern shops have installed schemes that have proved highly satisfactory. Their successes in overcoming difficulties are unquestionably due to the expert knowledge and experience possessed by the management and administration concerning the relative merits of various methods of applying bonus schemes, and to the existence of a rate-fixing department that can handle pattern making with a very small increase in expenditure. In the case of small pattern shops these helpful circumstances are not present, and consequently it is necessary to formulate means whereby the difficulties can be overcome in a somewhat different manner.

The chief problem to solve is the allocation of rate-fixing duties and responsibilities. There are three main alternatives, viz.: (1) For rates to be fixed by the pattern-shop foreman; (2) for rates to be set by a special rate-fixer, a practical pattern-maker, who can deal with pattern making alone; and (3) for rates to be set by the ordinary rate-fixing staff.

The first proposal, although very sound from all other points of view, must be rejected owing to the effect of its preclusion of the foreman from personal participation in any share of bonus. It is obviously impossible for an individual to receive bonus from the results of work on which he is the arbitrator of the basic amount to be performed, and, as will be explained later, any payment of staff bonus must be fundamentally based on its variation with production bonus. Therefore, unless it is decided that the foreman shall not receive extra payment above his wages, the use of this method must be negatived.

The second proposal is excellent from all operative points of view, but is restricted to use in cases where the amount of pattern making merits full-time employment of a special rate-fixer. This condition narrows its adoption, for very few firms carry out sufficient pattern work to necessitate such expense.

The third is the one which most foundries will be able to adopt in a fairly satisfactory manner. The obvious objection is that the rate-fixer, who is performing his job on the strength of his knowledge of moulding and other essentially foundry operations, will probably be unacquainted with practical details of pattern making. Consequently a system of bonus must be evolved which will allow the maximum of latitude with regard to the setting of bonus standards.

Premium bonus will be found to fulfil this latter condition in a more satisfactory manner than other methods of basing payment by results. An illustration of its advantage in this respect over piecework follows:—

A job is estimated to require the expenditure of 30 hours' work. Bonus rates must be calculated on the basis of allowing 33⅓ per cent. to be earned above time rates. The journeyman pattern-maker's hourly rate is 1s. 6d. The piecework price of the job will work out at 1s. 6d. × 30 × $\frac{4}{3}$ = 60s.

The premium bonus time for the job, on a 50-50 per cent. basis of apportionment will be 30 × $\frac{2}{3}$ hours = 50 hours. Both of these rates will ensure the man earning 2s. per hour, provided that he performs the work in exactly 30 hours.

Now, suppose that the basic time of performance has been estimated on the low side, and the job is carried out in 20 hours, at piecework rates the cost of the job is still 60s., and the man's rate works out at 3s. per hour. Under the premium bonus system the man receives 1s. 6d. × 20, plus $\frac{(1s.\ 6d. \times 30)}{2}$ = 52s. 6d., or 2s. 7½d. per hour.

It is assumed, of course, that this reduction in time of performance is due to incorrect rate-fixing and that no exceptional effort was brought forth, or that the man was not an extraordinarily fast worker. On this showing, premium bonus will allow far more latitude in setting rates, without fear of bonus being earned in great excess owing to the setting of too liberal bonus times. The distinction must be clearly understood between high bonus earned through incorrect rate-fixing and high bonus earned through more than average skill, quickness or adaptability.

Every inducement must be offered as encouragement to the attainment of high earnings in the second form, but the first will naturally be avoided as far as possible, and its effect can be minimised by premium bonus to a greater extent than by any alternative scheme.

Bonus rates should be set on a job as a whole, and no attempt made to divide up amongst several men. Where it is necessary for two or more men to work on the same job they should be set a group time and all participate in any bonus earned. If either additional labour or labour of another grade is required, more men are put on the job, but the work is not split into operations or parts. For example, suppose the bonus time of a job is fixed at 40 hours, and three men work on the job at the hourly rate of 1s. 6d., and the first man works 12 hours, the second 8, and the third 4 hours, then the time saved is 16 hours and the bonus to be divided amongst the three men will then be 12s. Shared on the proportion of time worked, the first man receives 6s., the second 4s., and the third 2s.

This method of gang bonus will be found highly successful for use with pattern making, and is indeed about the only really practical method of applying payment by results to the particular work without either incurring excessive expense in maintaining the scheme or frequently making payment in excess of the actual value of work carried out.

(To be continued.)

Southern Foundries.

In connection with the announcement in our issue of July 22, regarding the temporary closing of the Southern Foundries, we are now informed that these works are again in full swing, having secured the necessary raw materials to resume six days a week.

SIR W. G. ARMSTRONG, WHITWORTH & COMPANY, LIMITED, have removed their London office from Great George Street, Westminster, to Kinnaird House, Pall Mall East, London, S.W.1.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Perlit Propellers.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—Mr. Young's letter in your issue this week is most interesting, and he is quite evidently referring to the discussion raised in my letter in your issue of July 8.

As I may have to refer to his reference to grain size in another connection, I leave any discussion of this for the moment.

In paragraph 3 of his letter Mr. Young makes a statement that Perlit propellers now being evolved are the first improvement he has witnessed in the manufacture of propellers. Whilst paying the greatest deference to Mr. Young's experience, might I ask him if he can make the same statement with regard to other equally eminent metallurgists or practical foundrymen?

In his last paragraph Mr. Young states that ever since he can remember ordinary cast-iron propellers have been prone to serious defects arising out of the metal and the methods of using it. My experience of cast iron was probably as lengthy when Mr. Young commenced as is Mr. Young's now, and I can confirm his statement from my own experience. Where we differ, however, is that he presumably claims the Perlit method of overcoming this difficulty as being the *only* one, whereas by the use of irons which are more expensive to purchase, these defects have been overcome before the birth of the Perlit process.

The crux of the whole matter is, therefore, is it cheaper from the point of view of final cost of propellers to select suitable, though somewhat more expensive, pig-irons, or to use the Perlit process? This is subject matter for investigation.

In my experience, which is so much longer than that of Mr. Young, ironfounders making propellers in the past have found prices of castings so cut that they would not use any but the cheapest irons, which is the reason there have been so many defects with pitting, etc., of propeller blades. Had shipping people generally been willing to pay the ironfounder a better price for castings so as to enable him to use more suitable irons, there would have been fewer defects to remedy.

Yours, etc.

E. ADAMSON.

Sheffield.
August 6, 1926.

Blast Furnace Metal Mixer Adapted for Foundry Use.

By H. ILLIES and A. HESSE-WORTMANN, Amberg, Bavaria.

Foundries which receive iron directly from the blast-furnace have to put up with the inconvenience that the taps are not uniform and that the metal is only available at certain times. If also the molten metal from the blast-furnace has to be mixed with metal that has been tapped from the cupola, it is in most cases impossible to get the desired chemical composition, because at the arrival of the hot metal from the blast-furnace the metal from the cupola is already molten. This inconvenience is specially felt in pipe foundries, which need a metal of uniform composition and temperature.

For this reason two oil-fired 25-ton mixers with flat hearths are operated in a large pipe foundry in Germany. They are tilted hydraulically, and receive all the iron that arrives from the blast-furnaces. In case the blast-furnace furnishes insufficient metal, cupola iron is added, and any quantity can be tapped at the desired time. The cupola is put in operation after the metal from the blast-furnace has arrived, so that the charge can be chosen to suit the requirements. If only hot material is charged, the consumption of oil is 1.8 to 2.0 per cent., and if cold material is added, the consumption of oil may reach 3 per cent., according to the charged quantity.

The low oil consumption is due, in addition to the suitable construction of the burners and their arrangement, to the use of hot blast which enters the furnace with 1,200 to 1,300 deg. C., whilst the

waste gases leave the furnace at only 180 to 200 deg. C. The atomisation of the oil is accomplished by means of compressed air. A suction fan behind the furnace sucks the waste gases alternately through two chambers, which are filled with a special checker work and serve to heat the air. The furnace is therefore always under the action of suction, which is responsible for the long life of the fabric. The roof and the hearth have each a life of 1,000 charges or more, whilst the chambers last much longer; in fact, they have not yet been repaired. The chambers form a unit with the furnace and tilt with it. Through this construction of the chambers and furnace proper, which are encased in steel plates, all repairs are avoided. The chambers are connected with the fan by underground channels, the connections to which are water-sealed, so that in the tilted position the burners do not need to be shut off. Platforms are provided around and on the roof of the furnace, which serve for manipulating the burners, which are always in operation on one side of the furnace, while the opposite burners are withdrawn. For charging cold material a 20in. hole is provided in the centre of the roof, which is normally shut by a cover. The molten metal is charged through the launder, which also serves as the tapping spout.

In these furnaces not only the temperature of the metal, but also its chemical composition, is easily controlled. The metal is said to be free from gases and never contains more than 0.06 per cent. S. The furnaces have been in operation since 1920.

A smaller furnace of the same construction of 2 tons capacity is being used with success for the production of malleable castings in place of an electric furnace previously used.

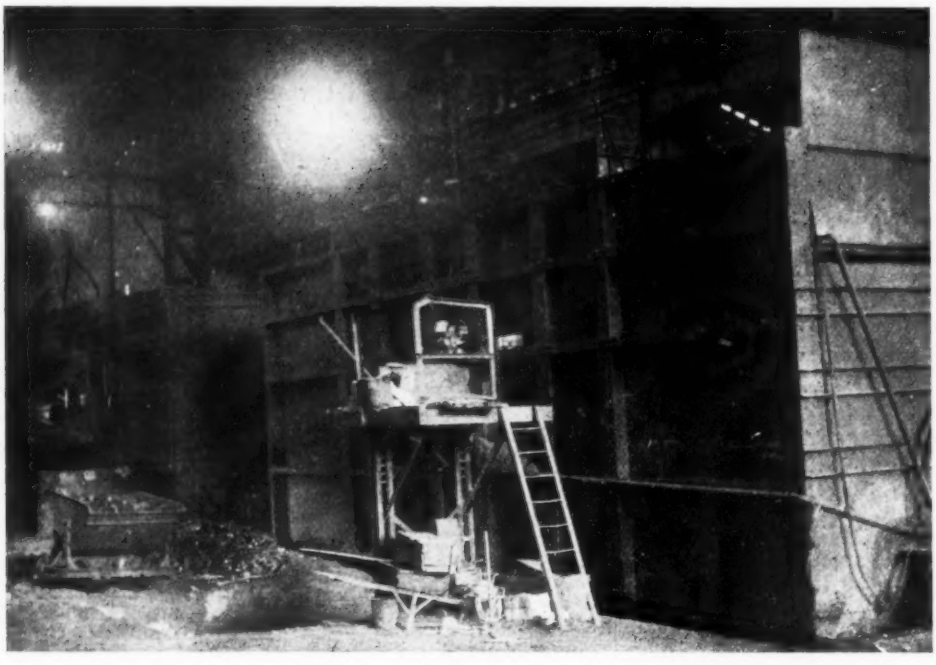


Fig. 1.—The Two Mixers in Normal Position.

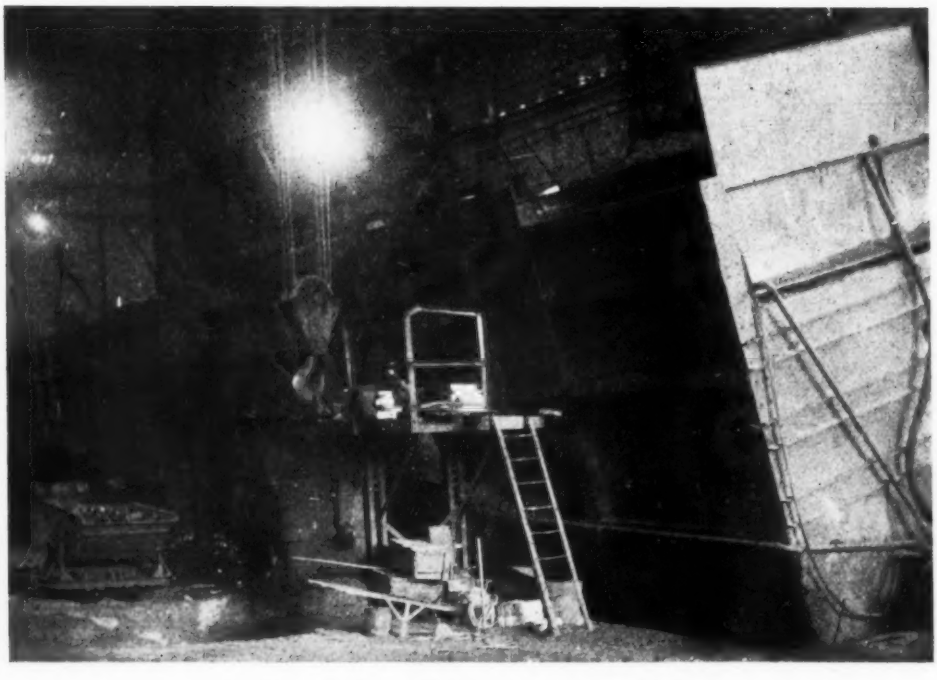


Fig. 2.—No. 1 Mixer in Tapping Position.

Carbon in Black-Heart Malleable.

By Christian Kluijtmans, B.Sc., M.A.T.F.

Liquid iron contains carbon in the form of a solution of iron carbide (Fe_3C) in iron. When solidifying austenite, which does not contain more than 2.20 per cent. of carbon, as carbide is first to be separated out. Next, the remaining

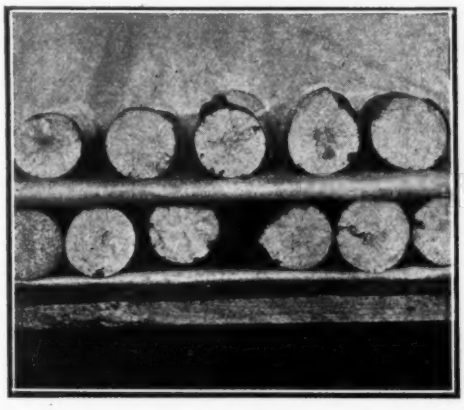


Fig. 1.—Fracture of the ½-in. Bars.

portion to solidify contains never more than 4.30 per cent. of carbon and is corresponding to the "eutectic cementite" and is a mixture of austenite and carbide. Cooling through the

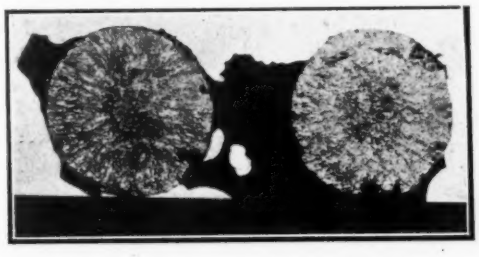


Fig. 2.—Fracture of the 1¾-in. Bar.

range 1,130 down to 700 deg. C., the austenite loses a part of its carbide and retains only 0.90 per cent. of carbon, which corresponds to the "eutectoid pearlite." The iron carbide formed

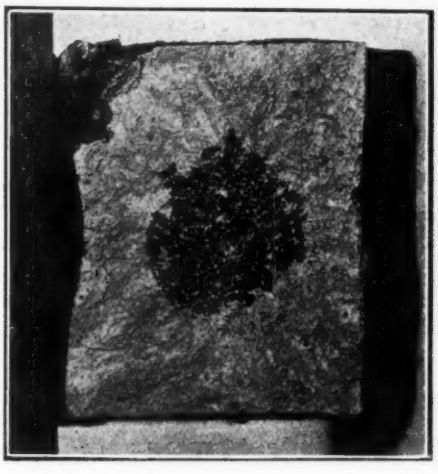


Fig. 3.—Fracture of the 2-in. Square Bar.

is white, hard and brittle, and is the only constituent which can be seen with the help of the microscope in white iron.

For black-heart malleable the carbon content must be between 2.20 and 2.60 per cent. Under 2.20 difficulties will be encountered in the foundry on account of the poor fluidity of such iron and chance of shrink. Over 2.60 per cent. of carbon, although this iron is quite suitable for moulding,

Fig. 4.—Micro. of the ½-in. Bar, showing Finely-divided Cementite Freezing at Right-angles to Cooling Face. All the Micros. shown are Etched 5 per cent. HNO_3 × 100 dias.

the higher carbon would produce "primary graphite," thus precluding satisfactory annealing and in any case yielding a weak casting.

Carbide of iron (Fe_3C) contains 6.70 per cent. of carbon and is called "cementite." It can exist in six different states:—

(*a*) As primary cementite, in iron containing more than 4.30 per cent. of carbon; (*b*) as eutectic

Fig. 5.—Micro. of the 1¾-in. Bar. Here the Cementite is Larger.

cementite, in iron containing more than 1.70 per cent. of carbon; (*c*) as pro-eutectoid cementite, in iron containing more than 0.90 per cent. of carbon; (*d*) as pearlitic cementite, being component

of the pearlite; (*e*) coalescent cementite, which state is the first stage of decomposition of the eutectic cementite during annealing; and (*f*) in alloys out of equilibrium, such as in chilled white iron, it is known that the quantity of cementite is proportional to the carbon content and that the rate of cooling has a marked influence on the size of the cementite, which may be finely divided

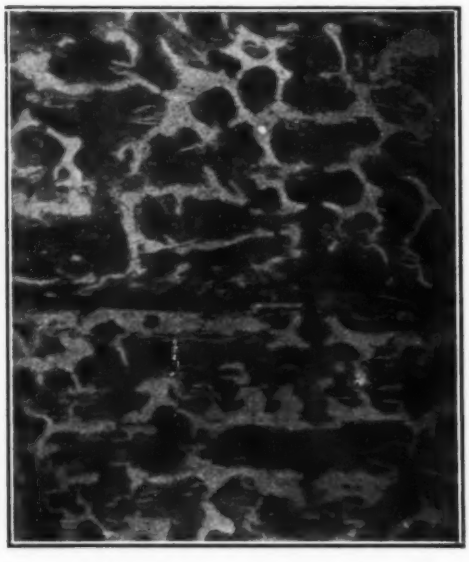


Fig. 6.—Micro. of the 2-in. Bar. The Cementite is still Larger.

as in the case of fast cooling or as large masses when cooling is very slow.

It had been noticed that in thick castings, about 2-in. section, the cementite was of two kinds: (1) Cementite formed at the edge of the section and (2) cementite formed in the centre of the section.

In the first case the cementite had been in direct contact with the sides of the mould, either

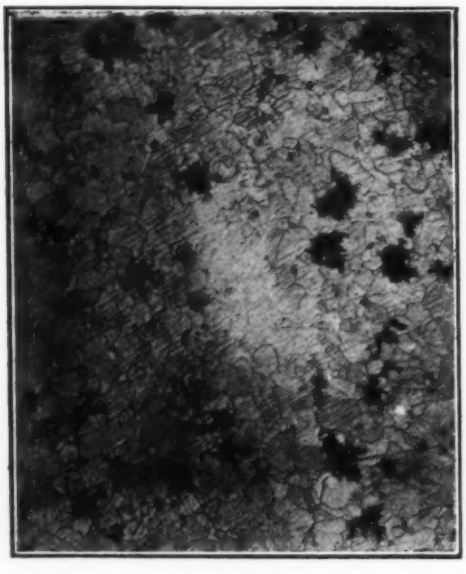


Fig. 7.—Micro. of the ½-in. Bar after Annealing, showing Fine Graphite (Black) well Distributed and Crystals of Ferrite.

sand or chill, and froze rapidly, its crystals being at right angles to the sides of the mould and widely distributed. This cementite is of the type outlined in paragraph (*f*).

In the second case, that is in the centre of the section, the portion which takes longer to solidify, the masses of cementite are larger and distributed hardly without any arrangement. This is the "eutectic cementite" described in paragraph (*b*). The difference between the two cementites cited above is not great as in (*f*), the cementite formed is the "eutectic cementite" but which has undergone a rapid cooling. The main difference lays in its shape, size and arrangement in the mass of iron.

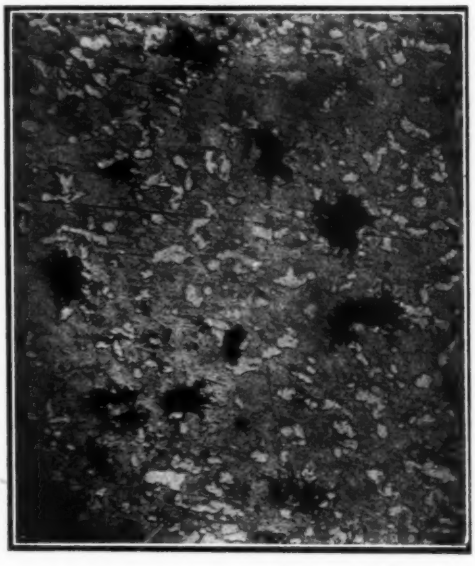


Fig. 8.—Micro. of the 1½-in. Bar after Annealing, showing Medium-sized Graphite; Coalescent Cementite (White Spots), and a Ferrite Groundwork.

From the above desiderata the author had cast several test bars of different thicknesses, including ½-in. and 1¾-in. dia. and 2-in. × 2-in. square bars, 10 in. long. They were poured from the same heat and about in the middle of the operation. The analyses were as follows: Silicon, 0.78

Fig. 9.—Micro. of the 2-in. Bar after Annealing, showing Coarse Graphite; Eutectic Cementite as Network (White), and Coalescent Cementite (White Spots).

to 0.82; carbon, 2.52 to 2.57; and manganese, 0.26 per cent. They were poured in sand and were allowed to cool in the mould. The rate of cooling was on the basis of being sufficiently cold to handle: ½-in. bar, 2 hours; 1¾-in. bar, 4 hours; and 2-in. square bar, 15 hours.

They were broken and the nature of fracture noted. The ½-in. bar showed small crystals with an orientation towards the centre; the 1¾-in. bar well formed crystals, with granular crystals in the centre; and the 2-in. bar had large, well-formed crystals and a shrink in the centre.

They are shown in Figs. 1 to 3. A sample from each was taken for microscopic examination (Figs. 4 to 6), which confirmed that the slower the cooling, the larger the masses of cementite.

The bars were then annealed together in the same pot, the temperature being recorded by a pyrometer placed inside the pot and close to the bars. The thermal history is set out in Table I:—

TABLE I.—*Thermal History of Annealing Cycle for Experimental Bars.*

Period.	Range.	Elapsed Time.
Heating up..	20° C. to 730° C.	24 hrs.
	730° C. to 840° C.	12 hrs.
Annealing ..	at 840° C.	45 hrs.
Cooling ..	840° C. down to 700° C.	36 hrs.
	800° C. down to 100° C.	48 hrs.
		165 hrs.

On breaking the fracture of the bars showed the ½-in. bar to be silky grey, the 1¾-in. bar to be grey, but slightly granular and showing a few white spots. The 2-in. bar was grey, but had a coarse grain and showed numerous white spots. On analysing the ½-in. bar was shown to contain 1.97 per cent. graphite and no combined carbon; the 1¾-in. bar had 1.63 per cent. graphite and 0.35 per cent. combined carbon, whilst the square bar still retained 0.78 per cent. combined carbon and 1.31 per cent. graphite. Thus the whole of the cementite had been decomposed into graphite and ferrite in the small bar, whilst in the large bar a large percentage of cementite had not been decomposed. Microphotographs of the annealed bars are shown in Figs. 7 to 9.

Physical Tests.—Only the small bars were tested, and gave 22 tons per sq. in. maximum stress, associated with 15.5 per cent. elongation on 2 in.

It was not thought necessary to prepare test bars from the larger bars on account of the loss of comparative value after the removal of the skin. As a result of the trials, it was concluded that, for similar annealing conditions, the larger the initial masses of cementite the larger the resultant graphite.

The Institute of Metals.

At the Liége meeting, to be held on September 1-4 next, the following Papers will be submitted:—

(1) "The Deformation of Tungsten Crystals," by C. J. Smithells, D.Sc., H. P. Rooksby, and W. R. Pitkin.

(2) "A Comparison of Static and Dynamic Tensile and Notched-Bar Tests," by Professor Kôtarô Honda, Sc.D.

(3) "The Constitution and the Physical Properties of the Alloys of Cadmium and Zinc," by C. H. M. Jenkins, B.Sc., A.R.S.M.

(4) "Some Further Experiments on the Behaviour of Single Crystals of Aluminium under Reversed Torsional Stresses," by H. J. Gough, M.B.E., B.Sc., S. J. Wright, B.A., and D. Hanson, D.Sc.

(5) "Silumin and Its Structure," by Buntaro Otani.

(6) "The Primitive Copper Industry of America. Part II," by G. Brinton Phillips, A.B.

(7) "The Constitution and Age-Hardening of some Ternary and Quarternary Alloys of Aluminium containing Nickel," by Kathleen E. Bingham, M.Sc.

(8) "The Constitution and Structure of the Commercial Aluminium-Silicon Alloys," by A. G. C. Gwyer, B.Sc., Ph.D., and H. W. L. Phillips, B.A., A.I.C. With an Appendix upon "The Properties of the Modified Aluminium-Silicon Alloys," by D. Stockdale, M.A., Ph.D., and I. Wilkinson, A.M.C.T.

(9) "Some Mechanical Properties of Silicon-Aluminium Alloys," by J. D. Grogan, B.A.

(10) "The Action of Hydrogen on Hot Solid Copper," by Cyril S. Smith, B.Sc., D.Sc., and Professor Carle R. Hayward, S.B.

(11) "The Development of the Use of Nickel in Coinage," by Captain F. R. Barton, C.M.G.

(12) "Season-Cracking in Arsenical Copper Tubes," by A. Pinkerton and W. H. Tait.

(13) "Thermal Anomalies of Certain Solid Solutions," by Professor P. Chevenard.

(14) "Preliminary Experiments on the Copper-Magnesium Alloys," by W. T. Cook, B.Sc., A.I.C., and W. R. D. Jones, M.Sc.

(15) "Bronze Worm Gear Blanks Produced by Centrifugal Casting," by F. W. Rowe, B.Sc.

(16) "An Account of the Non-Ferrous Metals Industry in the Liége District," by L. Boscheron.

How to Avert Strikes.

Sir R. Hadfield's Plan for Conciliation.

Sir Robert Hadfield, Bart., in an interview with a representative of the "Yorkshire Evening News," insisted that strikes and lock-outs were barbarous weapons that should, and can, be done away with. "Before I outline my plan, which I firmly believe would help to nip industrial disputes in the bud," said Sir Robert, "I am going to show how much labour troubles have cost my company's employees alone in the past.

"The total value of wages lost by my company's workpeople owing to industrial strife in the past twelve months amounts to close upon £1,000,000 sterling. The whole of these strikes, with one or two minor exceptions, were brought about by trade union orders. There was no dispute existing between the workers and ourselves. They received the command to 'down tools,' and they obeyed it.

"Quite apart from the loss in wages, my company sustained a heavy financial set-back. That in itself may have given some satisfaction in trade union quarters, but I am sure it did not lessen the blow received by their men. By the action of their pontifical mentors the cause of the workers was advanced not one whit.

Disastrous Stoppage.

"Just one more instance. After the Great War there was a disastrous strike of the moulders. Again we had no personal quarrel with our men, yet virtually the whole of our moulding work was stopped for many months. In the end the workers came back to their jobs half starving, and we had to advance them money to carry on.

"Thus it will be seen that in the majority of cases each side suffers much futile hardship and loss. No thinking person can commend a system which not only tolerates, but encourages, this kind of thing.

"Now, then, for the remedy. When Capital and Labour are at loggerheads, and the strike and lock-out stage is reached, another body should be called in. It should consist of a committee of employers and employed, should be elected by the nation, and should be quite independent.

"By such, or similar, means, further attempts at conciliation would be made, until a settlement is finally reached, and there would be no stoppage of work, no hardship inflicted on the employees, and no damage done to the employers.

System's Efficiency.

"At election times it would be a simple matter for the country to record votes for the men to sit on such a committee. If this were not done, the whole system might become so clogged by officialdom that it would be worse than useless.

"There is but little doubt about the efficacy of the system I advocate. It was put into practice with admirable results during recent trouble in the Greater London Electric Supply Industry.

"As a result of a long conference at the Ministry of Labour, strike and lock-out action on either side was averted. The conference consisted of six men representing the employers and six the trade union concerned. There was an independent chairman.

"In my view, there are few men who wish to be at loggerheads with their employers, and there is only a very small number of employers who want to oppress and bleed their workpeople."

Institute of British Foundrymen.

Discussion on Convention Papers.

Professor F. C. Thompson and Mr. M. L. Becker's Paper on "Some Notes on the Chemistry of the Cupola."

Mr. Horace J. Young, F.I.C. (London), asked the authors how to sample the gases from the cupola so as to obtain figures sufficiently accurate to conform with the intricate calculations in the Paper. He suggested that the Paper was entirely theoretical, and, although it ended with a statement which had been made by many people before, namely, that there was no need for two rows of tuyeres. The paper, in his view, was inconclusive, and he would be glad if the authors, when replying to the discussion, would state the conclusions to which they had come as the result of their work.

Mr. B. Hird considered that researches such as these into the gases given off by the cupola and their relation to the gases that were absorbed by the iron would bring a great deal of light and help to those who had to work cupolas and get results from them. During the last year he had carried out some experiments in connection with the gases contained in cast iron, wrought iron and steel, and they had left him very much fogged. He had been led to experiment because, when trying to cast a wrought-iron bar in a casting he had obtained serious blowholes. He had carried the experiment further by casting chills in moulds and attaching a tube to them, in order to see if he could get any gases therefrom; he was astonished to find that he obtained gases from every chill he used, and there were big variations, although the chills were cast out of the same ladle. Therefore, he very much appreciated the authors' attempts to deal with the matter. Gases formed in the cupola, in his view, were absorbed in the iron, and he asked the authors to carry on their work on the formation and absorption of gases.

Mr. J. E. Fletcher said he could not exactly subscribe to the view expressed by Mr. Young, but considered that the work done by the authors would prove to be of value. One point to be remembered—although he did not think the authors had entirely lost sight of it—was the fact that the speed of the gases through the cupola had something to do with the equilibrium factor in the gas analysis. It was assumed in too many of these cases, he was afraid, in connection with both the blast furnace and the cupola, that theoretical equilibrium was attained in the time in which the gases passed through either the blast furnace or the cupola, and that was where the difficulty arose in a purely scientific investigation, unless comparison was made with the actual facts of the case as recorded from properly-taken analyses at various points of the cupola. He had had considerable experience in trying to get these, and the results were not at all in accordance, in many cases, with the expectations of the authors. With regard to limestone, the amount of heat taken off by the expulsion of the CO_2 from limestone, of course, was very considerable. One question which had been scarcely touched upon was that of the ash in the coke. It had been proved that a percentage of ash in coke had a much greater effect on the thermal value of that coke than could be deduced theoretically, and points of that sort made one extremely cautious in accepting conclusions of a purely theoretical character. He had tried to use a slacked lime through the tuyeres of the cupola instead of introducing it as limestone with the charge. Dr. Stead and himself had had a conversation on the point some years ago, and it had been tried both in Middlesbrough and in the Midlands, but things did not happen as was expected. The attempt was made to introduce the lime as lime with the air blown into the blast furnace as well as the cupola, but slag was formed all round the cupola and next to the lining of the blast furnace, instead of the lime penetrating to the centre of the charge column. Those experimenting with cupolas must bear in mind that they must get the air distributed as perfectly as possible. Finally, he congratulated the authors upon their attempt to help practically by conclusions which at first sight were purely theoretical.

Mr. E. Longden said that while theoretically the single row of tuyeres in a cupola was ideal, it was not so in practice. There was much more slagging up of tuyeres than with two rows.

AUTHOR'S REPLY.

Mr. M. L. Becker, replying to Mr. Young, said it was difficult to convey the whole of the contents of the Paper in the course of the short time allotted to him for introducing it, and it was also extremely difficult for others to discuss the Paper without having read it, but he would be pleased to reply to any further criticisms which might be made in writing. With regard to the sampling of gases, he said it was pointed out in the Paper that the conclusions arrived at were entirely theoretical, and the authors had not as yet taken samples of gases from cupolas, but hoped to do so. They considered it advisable, however, to set down the lines on which they proposed to make the experiments, and later, if time permitted, the experiments would be made and the results probably reported. It was a very difficult matter to sample gases from a cupola, but the method they had in view was to drop a pipe down the centre of the cupola and put it in with the charge. So far as could be ascertained, the method of sampling gases at the edge of the cupola was quite unsatisfactory, because the gases rising at the centre of the charge were of different composition from those at the edge of the charge, next to the lining. Also, the temperature varied very much as between the centre and the edges. The authors had not been able to go into the question raised by Mr. Hird, namely, of determining how far the gases affected the properties of the iron cast, but had simply taken the cupola as a heat generator, with the idea of finding out how much heat was required to get the iron out at a certain temperature. Nevertheless, the ratio of carbon monoxide to carbon dioxide in the melting zone must be of profound importance when considering the quality of the iron tapped from the cupola. If the ratio of carbon monoxide to carbon dioxide was not very great, the immediate result would be the oxidation of the iron. He considered that if that went on to any great extent that the metal itself might contain oxide, either in solution or otherwise, and give an unsuitable casting. Dealing with Mr. Fletcher's point as to the rate at which the gases passed through the charge, he said the authors wanted to know if anybody had practical information on the subject; if anybody could give any direct evidence that they were wrong they would be only too pleased, because their object in giving the paper was to find out where they were. The effect of ash in the coke was not dealt with, but was simply taken as 12½ per cent. The fusibility of the ash and the formation of slags, of course, must enter into the question, but, at the same time, the calorific value of coke of a given ash content, he believed, was more or less constant. With regard to the introduction of lime at the tuyere zone, he had heard of others who had done that without success, and that seemed to bear out the conclusion which the authors had arrived at, namely, that the effect of the limestone was very slight indeed so far as the heat balance was concerned. The authors had not expressed an opinion in the paper as to whether a single or a double row of tuyeres was advisable, but they did wish to make the point that extra air introduced at a considerable distance up the cupola stack, in order to burn the carbon monoxide originating in the stack, had not been found to be satisfactory.

To Harden Hammers, Wedges, etc.—Mix together two parts of bone dust, three parts of ordinary table salt, one part of burnt leather shreds, and one part of prussiate of potash. Heat the whole mixture to a cherry-red heat, and immediately immerse the articles into the mixture. Leave them in the mixture until they are practically cool.

Treatment of C.I. Firebars.—The life of firebars, it is said, can be considerably lengthened if sprayed with a coating of aluminium. Attention, however, must be paid to the mixing of the metal, and it is advisable to use a good percentage of cast-iron scrap, along with hematite (Scotch) and good aluminium scrap. The less the P. and S. content the better.

A Note on "Growth" in Cast Iron.

By J. E. Hurst.

In a previous article (in THE FOUNDRY TRADE JOURNAL) on the behaviour of cast iron when subjected to conditions of high temperature, the writer discussed the influence of the thermal expansion in bringing about the growth phenomenon. The actual cause of the ultimate disintegration of grey cast iron when subjected to repeated heatings and coolings has been a matter of considerable interest since Carpenter and Rugan's experiments. This point was raised by Saniter in the discussion on these experiments, and has been studied by various Japanese workers. In the previous article above mentioned, the writer was of the opinion that the thermal expansion was the primary cause in promoting growth at all temperatures, and that the chemical phenomena associated with growth, such as the precipitation of carbon and the oxidation of certain constituents, were to be regarded as secondary causes and effects.

In considering this subject further, it is necessary more particularly to define the growth phenomenon. In industrial cases in which growth occurs, the cast iron is subjected to a wide variety of conditions of temperature, reversals of temperature, and character of the gaseous atmosphere. Apart entirely from any considerations of thermal expansion, all these conditions will influence the extent of oxidation of the constituents of the cast iron and the decomposition of the carbides. In this manner in their turn these various conditions will have a corresponding influence on the extent of the growth. There must be many industrial cases where growth to the extent of disintegration takes place, in which these chemical phenomena have greater influence than others, and in the complete and final conception of the "growth" phenomenon these chemical factors will have to be taken into consideration.

For the time being the writer prefers to apply the term "growth phenomenon" to those cases of volume changes which occur at comparatively high temperatures—above 600 deg. C.—and which usually result in the final disintegration of the cast iron. In adopting this course, a distinction is being drawn between volume changes at high temperatures and those at low temperatures, such as have been deeply investigated by Donaldson.* This distinction might finally be shown to be purely arbitrary, and, in any case, the distinction does appear to have been tacitly drawn by Carpenter and Rugan in their extended investigations. The phenomenon of growth can now be considered on the basis of a simplified definition that growth can be regarded as the failure of the material to withstand the stresses set up by the fluctuations in temperature, without disintegration.

It is of interest to recapitulate the manner in which these stresses are set up within the material. If we imagine a bar of cast iron in the process of heating, and we imagine this bar to be built up of a series of layers of minute thickness, the outer layers become heated to a particular temperature before the inner layers. A temperature gradient thus exists across the section of the bar for a period of time until uniformity of temperature is established, and the bar is said to be evenly heated. On cooling down, exactly the reverse of this state of affairs is the case, and a temperature gradient exists from the centre of the bar to the outside layers until the bar is uniformly cool. The continued heating and cooling of the bar results in the continued reversal of the temperature gradient across the section of the material. The existence of temperature gradients implies the existence of expansion gradients, which in their turn imply the existence of stress gradients. The stress gradients set up across the section of the material are being constantly reversed in direction in the case of bars which are being heated and cooled, and it is the failure of the material to withstand these stresses which results in the growth phenomenon. Considerable support of an experimental nature is given to this view as the cause of growth by the experiments of Durand,* who found that the extent of growth, in addition to being proportional to the silicon content, was also proportional to the rate of heating. Durand's experiments were carried out over a range of temperature of from 600 to 900 deg. C., and the measurements were performed by means of a dilatometer. He found that the growth varied inversely as the rate of heating and directly as the silicon content.

The study of the stress gradients or of the temperature gradients and their relation to the stress causing failure in the material will possibly be of value in throwing more light on the phenomenon of growth, and in showing the direction which further investigation should take. In this direction it is of considerable interest to refer to the work which has been done on the spalling tendency of refractory materials in the shape of bricks by Le Chatelier, Winkelmann and Schott, F. H. Norton, and Green and Dale. The analogy between this phenomenon in bricks and the growth phenomenon in cast iron appears to the author to be very striking.

The factor to be taken into consideration in determining the tendency to growth are those which determine the temperature gradient and those which determine the stress conditions producing failure or rupture in the material. F. H. Norton, in his consideration of the spalling tendency of refractory materials, has introduced the factor of maximum shearing strain, which is defined as the maximum distance a plane in the material can be moved parallel to another plane without rupture. In his formula the spalling tendency is related to the maximum shearing strain as follows:—

$$S = \frac{E\, s_1}{F_1 \sqrt{h^2}}$$

Where:—S = the spalling tendency,
E = the coefficient of expansion,
F = the maximum shearing strain.
h^2 = the diffusivity,
s_1 = a "size" factor.

Winkelmann and Schott have propounded the somewhat different formula:—

$$S = \frac{E}{\frac{T}{M}\sqrt{h^2}}$$

Where S and E and h^2 have the same significance as above, and T = the tensile strength,
M = the modulus of elasticity.

Both these formulæ indicate that the spalling tendency is directly proportional to the coefficient of expansion and inversely proportional to the diffusivity and a strength factor.

The Temperature Gradient and Diffusivity Factor.

The rate at which heat is transferred in a body under given temperature conditions depends upon the thermal conductivity, and the rise in temperature produced by this heat depends, in addition, on the specific heat (c) and density (p) of the body. The relation $\frac{k}{cp} = h^2$ where k is the thermal conductivity gives the constant h^2, which has been termed by Maxwell the thermometric conductivity, but is generally referred to as the diffusivity.

The diffusion of heat within a body can be considered on the basis of the linear flow of heat in a semi-infinite solid with one bounding face at a constant temperature zero, and the initial temperature θ_0 throughout the body. The fundamental Fourier conduction equation is:—

$$\frac{\delta\theta}{\delta t} = h^2 \frac{\delta^2\theta}{\delta x^2}$$

The solution of this differential equation for the above conditions, X = O, θ = O, and $\theta = \theta_0$, when t = O is:—

* I.B.F. Annual Convention, 1925.

* Comptes Rendues 1922. Vol. 175, pps. 522-524.

$$\theta = \frac{2\theta_0}{\sqrt{\pi}} \int_0^{\frac{x}{2h\sqrt{t}}} e^{-\beta^2} \frac{}{\alpha\beta}$$

Differentiating this with respect to x, the distance from the bounding plane, the temperature gradient $\frac{\delta\theta}{\delta x}$ is obtained as follows:—

$$\frac{\delta\theta}{\delta x} = \frac{\theta_0}{h\sqrt{\pi t}} e^{\frac{-x^2}{4h^2t}}$$

This equation defines the temperatures at various planes within the body at a distance x from the boundary surface after definite intervals of time, and shows at once that the temperature gradient is inversely proportional to the quantity h, the square root of the diffusivity of h^2. If t is taken as a large quantity, and θ_0 and π constant under a given set of conditions, the equation reduces to:—

$$\frac{\delta\theta}{\delta x t} = \frac{C}{\sqrt{h^2}} \text{ where C is a constant.}$$

The Norton formula is derived from the relation evolved by him that:—

$$F = S_1 E \frac{\delta\theta}{\delta x}$$

where the shearing strain F set up in the body is proportional to the size, coefficient of expansion and the temperature gradient. If the spalling tendency is regarded as the ratio of the shearing stress to the shearing strength of the material, f and f_1 respectively, and the temperature gradient $\frac{\delta}{\delta x}$ is regarded as equal to $\frac{C}{\sqrt{h^2}}$ we obtain

$f = F.R.$

Where f = shearing stress,
F = shearing strain,
R = coefficient of rigidity,

and the ratio of shearing stress to the shearing strength:—

$$\frac{f}{f_1} = \frac{FR}{f_1} = \frac{S_1 E \frac{\delta\theta}{\delta x} R}{f_1} = \frac{S_1 E \frac{C}{\sqrt{h^2}} R}{f_1}$$

For brittle material $R = \frac{f_1}{F}$ where F is the maximum shearing strain. Therefore if S be taken as the spalling tendency:—

$$S = \frac{C S_1 E}{\sqrt{h^2} F}$$ this formula ignoring the constant C is the Norton formula given above.

In this formula F is the maximum shearing strain which is related to the shearing stress by the equation given above f = F.R. where R is the coefficient or modulus of rigidity. The Norton formula for spalling may be written as follows:—

$$S = \frac{C S_1 E}{\sqrt{h^2} \frac{F}{R}}$$

and in this form it is readily comparable with the Winkleman Schott formula involving the tensile-strength factor.

In both these formulæ the fundamental factors governing the spalling tendency are related to the three independently variable physical properties: (1) Temperature diffusivity; (2) ultimate shear strength or tensile strength; (3) temperature-volume relationship.

Application of these Deductions to Cast Iron.

In the particular definition of growth in cast iron there is no difference between this and the spalling phenomenon considered above in connection with refractory materials. For this reason it is perfectly legitimate to consider the application of the above formulæ of cast iron.

The only point in which the formulæ differ is in the use of the factors involving tensile strength and shear strength respectively. From the strict point of view of the elastician there is no doubt that the use of the term involving the shear strength is more fundamentally correct. The failure or rupture of a material subjected to tensile stress from the point of view of the elastician's analysis involves the ultimate failure by shear stresses. The relation between the tensile and shear properties is known, however, with sufficient accuracy for all practical purposes, and furthermore the tensile strength is a property which is by far more easily and directly measured. Under these circumstances the formula involving the tensile-strength factor is likely to be of more practical value at this stage. The term in the formula involving the strength factor in addition embodies the elasticity. The formula indicates that the spalling or growth tendency is inversely proportional to the maximum strain or inversely proportional to the maximum strength and directly proportional to the modulus of elasticity (or rigidity in the case of shear).

The importance of the elasticity factor cannot be over-emphasised. The tendency to failure of the material through growth is directly proportional to the elasticity or flexibility of the material, and it is highly probable that very small changes in the coefficient of elasticity will have considerable influence on the growth tendency.

The thermal expansion is directly responsible for the stresses set up in the material, and for this reason the factors involving this property and those determining the temperature gradient throughout the material in the formulæ are perfectly logical. Naturally under a given set of conditions the temperature gradient will depend on, in addition to the diffusivity, the size and shape of the particular piece of material. If the comparisons are made on similar shapes and sizes the size-factor term can be omitted from the formulæ.

Experimental work on the growth phenomenon in cast iron has not hitherto been extensively applied to the relationship between this phenomenon and the physical strength properties. In the case of volume changes which take place on heating cast iron—at comparatively low temperatures, lower than the temperatures of the growth phenomenon as defined in the earlier stage of these notes—some comparison between the volume changes and the strength properties has been indicated. Mellanby has stated that the resistance to volume changes in iron is directly proportional to the resistance to wear. Donaldson, in his experiments on growth and volume changes at low temperature ranges, obtains the maximum resistance to permanent volume changes in those irons having the highest tensile strengths at all ranges of temperature.

We have in these experiments partial proof of our previous deductions. Resistance to wear is in itself a complicated property and is not easy of mathematical analysis. It is highly probable that the ultimate strength and the elasticity are involved in the property resistance to wear. For this reason Mellanby's observation on the relationship between resistance to wear and to permanent volume changes is of great importance. It is necessary to point out that whilst these experimental observations have been made in connection with permanent volume changes at lower temperatures than those of the definition, there is probably very little difference between the phenomena at low temperatures and those at high temperatures, apart from the chemical aspects. It would be quite legitimate to expect that the relations we have deduced would hold in both cases.

It is generally agreed that the deposition of graphitic carbon is to a large extent responsible for the permanent volume changes at low temperatures, and the effect of the oxidation of the various constituents must be taken into consideration in the growth phenomenon at higher temperatures. The repetition of the heatings and coolings have also to be taken into consideration. The writer has previously stated that in his opinion the internal oxidation of the constituents may be regarded as a secondary effect.

The application of some of the reasoning which has been applied in the consideration of the spalling tendencies of refractory materials has been applied to the growth phenomenon in cast iron. It would appear that a useful purpose would be served in further investigations of the growth and permanent volume changes in cast iron to give some attention to their relation to the strength and elasticity factors and to the temperature expansion gradients set up under different conditions of heating.

The Influence of Hot Steam on Cast Iron.

Dr. Piwowarsky describes experiments made in order to examine the influence of hot steam on cast iron in a recent issue of "Die Giesserei." The composition of the charges, made from the purest raw materials, is set out in Table I. The test bars had a length of 3.54 in. and a diameter of 0.315 in. They were heated in an electric resistance furnace for 75 hours at 300 deg. C.

Table I.

Charge No.	Total C. per cent.	Graphite per cent.	Si. per cent.	Mn. per cent.	S. per cent.	P. per cent.	Cr. per cent.
I ..	3.55	2.78	2.13	0.5	below 0.03	traces	—
II ..	3.04	2.03	1.08	0.43	,,	,,	—
III ..	2.89	1.73	0.97	0.46	,,	0.63	—
IV ..	2.98	1.64	1.14	0.47	0.12	traces	—
V ..	3.42	0.06	1.00	0.48	below 0.03	,,	1.12

(series I), 350 deg. C. (series II), 450 deg. C. (series III), in steam at atmospheric pressure. The bars were weighed both before and after the heat treatment.

The increase of weight in per cent. of the original weight is set out in Table II. The samples

Fig. 1.—Unetched × 100.

of charge I show the highest values. An increase of length could not be stated, but the diameter had grown by the formation of an oxide layer.

Table II.

Series.	Charge				
	I.	II.	III.	IV.	V.
I (300° C.) ..	0.41	0.38	0.25	0.23	0.27
II (350° C.) ..	0.85	0.70	not determined	0.64	0.82
III (450° C.) ..	2.80	1.93	1.86	1.89	1.72

The increase of volume during the heat treatment at 450 deg. C. is set out in Table III (in per cent. of the original volume). The oxide layer

Table III.

Charge I.	Charge II.	Charge III.	Charge IV.	Charge V.
10.2	4.4	4.2	6.6	5.4

was removed by hot caustic soda solution and zinc dust and the loss of weight measured (Table IV). Next to charge I (high silicon), the sample IV (high sulphur) had the largest increase of volume

Table IV.

Series.	Charge				
	I.	II.	III.	IV.	V.
I (300° C.) ..	0.88	1.20	0.57	0.61	0.69
II (350° C.) ..	1.28	2.00	not examined	1.26	2.25
III (450° C.) ..	6.90	5.00	4.70	3.40	4.20

but the smallest loss of weight. This fact may lend strength to the thought that the oxidising and corroding effect of the steam enters to a different extent into the interior of the different samples and cannot be completely measured by the removal of the scale (loss of weight). Therefore the oxygen content of the interior parts of the samples was examined by the extraction method at 1,200 deg. C. and the chlorine condensation method at about 400 deg. C. The values obtained by the former method are recorded in Table V.

Table V.

Series.	Charge				
	I. per cent.	II. per cent.	III. per cent.	IV. per cent.	V. per cent.
Untreated ..	0.032	0.031	0.025	0.014	0.006
I (300° C.) ..	0.054	0.029	0.022	0.045	0.005
II (350° C.) ..	0.163	0.033	not examined	0.043	0.008
III (450° C.) ..	0.684	0.053	0.051	0.422	0.015

It is to be seen that the oxygen content is at a maximum in charge I (high silicon, with large graphite flakes, Fig. 1), which had the largest increase of weight and volume. The analysis of the residue of the chlorine method showed that the growth of the bars is caused by the oxidation

Fig. 2.—Unetched × 100.

of the silico-ferrite, though the real cause may be the coarse-grained texture of the matrix. Charge II (low in Si, P, S), which has a better distribution of the graphite (Fig. 2, short lamellæ), only shows a small oxygen content in the interior parts. The case is entirely the reverse with

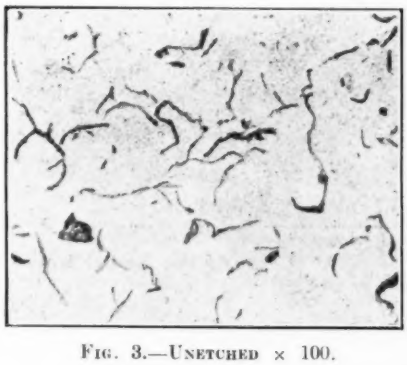


Fig. 3.—Unetched × 100.

charge IV (high in S), though it shows a rather fine distribution of the graphite (Fig. 3). This fact is of great importance, as it is generally suggested that the sulphur hampers the growth at high temperatures. Experiments in this direction are to be continued. Charge V (containing chromium), which had a white fracture, demonstrates the beneficial influence of a dense texture. The changes of the graphite and the total carbon contents of the charges are recorded in Table VI,

wherein it is demonstrated that a decomposition of the carbide occurred to a larger extent only in charge I. But, as can be shown by calculation, this decomposition only plays a lesser part in the growth of the bars. The microscopical examination showed that the oxidation started from the

Table VI.

	Charge				
	I.	II.	III.	IV.	V.
	Untreated.				
Total carbon ..	3.55	3.04	2.89	2.98	3.42
Graphite ..	2.78	2.03	1.73	1.64	0.06
Combined carbon	0.77	1.01	1.16	1.34	3.36
	Series I (300° C.).				
Total carbon ..	3.44	2.94	2.85	2.95	3.40
Graphite ..	2.72	1.92	1.71	1.63	0.08
Combined carbon	0.72	1.02	1.14	1.32	3.32
	Series II (350° C.).				
Total carbon ..	3.37	2.84	not examined	2.90	3.31
Graphite ..	2.70	1.85	,,	1.63	0.14
Combined carbon	0.67	0.99	,,	1.27	3.17
	Series III (450° C.).				
Total carbon ..	3.09	2.83	2.71	2.73	3.08
Graphite ..	2.79	1.87	1.99	1.73	0.21
Combined carbon	0.30	0.96	0.72	1.00	2.87

surface of the bars and advanced into the interior along the graphite flakes; flakes, however, which had no direct connection with the surface were

Fig. 4.—Unetched × 100.

oxidised, too. Fig. 4 shows the formation of temper carbon around the original graphite lamellæ in the samples III and IV.

Publication Received.

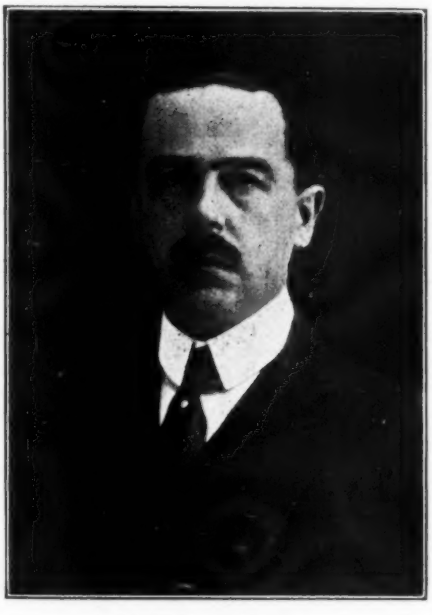
British Engine Boiler and Electrical Insurance Company, Limited, 24, Fennel Street, Manchester, Technical Report for 1925. Price 7s. 6d.

A perusal of this report cannot fail to impress upon the foundryman the need for obtaining some definite knowledge as to the action of water hammer on cast-iron pipes. We are unaware whether engineers can reproduce water hammer at will and measure satisfactorily its effect. A substitute test which suggests itself is repeated impact, and foundrymen should familiarise themselves with this test and offer to engineers for parts liable to be subjected to water hammer and sound castings made from material showing high impact figures. The report is very instructive, but would be more interesting for our readers if it contained more metallurgical studies of the cast irons which have failed in practice.

The eighth Model Engineer Exhibition opens on September 17 for one week, at the Royal Horticultural Hall, Westminster.

Belgian Foundrymen's Association's New President.

Mr. Ropsy is managing director of the Belgian Griffin Foundry at Morxem, near Antwerp, where a speciality in the form of chilled railway truck wheels has been created in addition to various forms of chilled rolls. It is Mr. Ropsy's ambition, during his tenure of office, to form branches of the Association. He proposes to visit the



Mr. Paul Ropsy.
(*The Newly-Elected President of the Belgian Foundrymen's Association.*)

Detroit Convention next month as representing his Association. He has made a speciality of foundry costing, and has read Papers on this subject. He has created at his works a thoroughly up-to-date laboratory equipment, and a steady stream of research papers can be expected from them in the future.

Book Review.

Die Selbstkosten Rechnung in der Eisengiesserei.—By Dr. Ing. A. Lischka. Published by R. Oldenbourg, Verlag, 8, Gluckstrasse, Munich. Price (paper bound) 6.50 gold marks.

Whilst abundant papers on foundry costing have been published in the English language, there are but few books devoted to the subject. In German, however, there are quite a number to choose from, and that may account for the fact that, in general, German foundries do cost on proper lines, and, in consequence, enjoy a relatively higher financial status than in this country. In general, Dr. Lischka's method of tackling the proposition agrees with those which have been outlined from time to time by British workers. In the ascertainment of costs, the author first deals with interest on capital invested, debenture and preference stock; motive power; overheads and raw materials. After a few notes on buying, the costs to be associated with melting are dealt with, leading up to the cost of the liquid iron. Foundry costs—hand and machine moulding, core making, cleaning, and pattern making—are each separately considered. A second section is devoted to the establishment of cost price for groups of castings and the individual piece, whilst the third considers in detail the production of statistics for the guidance of the management. Finally, an excellent bibliography of the subject is given. We thoroughly recommend the reading of this book by all who can translate German, for it is our sincere belief that a concentration of foundry costing in all its aspects would benefit very considerably the British foundry industry, taken as a whole.

The Examination and Analysis of Cupola Slag.

By H. H. Shepherd.

(*Continued from page* 100.)

The Determination of Silica.

Determinations of silica and other impurities present in the fusing and other reagents used must be made. Therefore, along with the decomposition and analysis of the sample a test must be made, *i.e.*, treat the same amounts of fusing reagents as used for the sample in exactly the same way as the latter, through the whole series of analyses, including the decomposition; if the blank is analysed side by side with the sample one is readily able to detect and estimate any impurities which would affect the accuracy of the results.

Solutions Required.—A 50 and a 25 per cent. solution of hydrochloric acid.

Method.—When the completely-decomposed sample is cooling take a 400 c.c.s. well-shaped squat form beaker and a well-shaped cover glass, and wash the crucible lid with hot water, allowing the washings to run into it. Then half-fill the crucible with water and gently heat the contents over a small flame for two or three minutes. Transfer the liquid to the beaker, and wash the crucible sides to prevent "dripping," then repeat the water treatment of the residue in the crucible until the whole is dissolved out. Finally wash the crucible, using the "bobby" to clean it thoroughly. The bulk of the solution should not measure more than 50 c.c.s. at this stage. The method of extraction may seem a slow one, but the writer's experience is that after a little practice this method is not only a rapid means of extracting and dissolving the residue, but it also enables one to keep the bulk of solution low. It is necessary, however, to treat with *fresh* supplies of water every two or three minutes.

To the water-extraction add carefully 25 c.c.s. of concentrated HCl, place the cover glass over the beaker, and then evaporate the solution as low as it can be taken without loss by "spattering." To do this, the solution is best boiled rather rapidly until it approaches a syrup consistency. Heating over an ordinary wire gauze with a bunsen flame will be found a reliable method. From this point evaporation should be continued by heating on a hot plate and allowing evaporation to proceed slowly to dryness. When the mass is quite dry, bake for 30 minutes on the hottest part of the plate, then allow it to cool sufficiently to enable one to handle the beaker, remove the cover glass and wash it with hot water; wash also the beaker sides, and detach any particles of salts adhering to the beaker; then add 20 c.c.s. conc. HCl, and again evaporate to dryness and bake for the same time as before. After the second baking is complete and the beaker cool, add 15 c.c. of conc. HCl, and wash the cover glass and beaker sides as before, using as little water as possible. Heat the mixture to boiling, and when all the salts appear to have dissolved add 50 c.c.s. of hot water; just bring to boiling again. This operation must be carefully watched, as "bumping" occurs when the solution commences to boil. It may be somewhat minimised by stirring the liquid gently and constantly until it boils. Allow the silica to settle, then filter off through a 12.5 c.m. filter paper of the "Whatman No. 40" type, allowing the filtrate to run into a 600 c.c.s. tall form beaker; transfer the silica residue to the filter paper and clean the beaker well with the aid of the "bobby" and a jet of hot water. The filtrate should be passed through the filter a second time, as during the first filtering some of the finely-divided silica passes through the paper. When the second filtration is finished wash the residue and filter twice, washing alternately with hot 25 per cent. HCl and water, then three or four times with water; the last washing, that is with hot water, should drive the silica well into the apex of the filter. Remove the filter, fold it so that there are several thicknesses of paper under the silica residue, then place it in a porcelain or platinum crucible. Dry the filter and residue and allow the paper to char by placing the crucible in front of the muffle, after which place it inside and in the hottest part, which should be at bright red heat. Ignite for 30 minutes, then remove the crucible to a dessicator to cool.

Many chemists consider that it is necessary, to secure accurate results, to treat the residue with hydrofluoric acid, and determine the silica by the loss in weight. For ordinary works laboratory routine this method is not recommended, especially when the amount of silica is large, for a considerable amount of time is taken up in endeavouring to volatilise the whole of the silica, without any recompensing feature in the accuracy of the result; in fact, there is a very serious risk of large errors arising from the use of this method. For most practical purposes the percentage of silica found can be accepted as the total amount of silica, but if greater accuracy is required it becomes necessary to evaporate the filtrate from the silica down to dryness, and to take up as before in HCl, dilute with water and filter off the small amount of silica which previously had been dissolved in the acid solution. This amount is then calculated as a percentage and the result added to the first figure obtained for the silica. It will usually be found to range from 0.20 to 0.50 per cent., according to the treatment the sample has received.

Separation of Al from the Ca, Mg, Fe, and Mn Salts.

Solutions and Reagents Required.—30 per cent. solution of sodium carbonate made from the anhydrous salt; 30 per cent. solution of sodium hydroxide; 50 per cent. HCl; conc. HNO_3; 50 per cent. solution of HNO_3; and anhydrous sodium carbonate.

Procedure.—Evaporate the filtrates (or the combined filtrates, if a determination of the soluble silica was made) to about 20 c.c.s. Wash the sides of the beaker well and then dilute to about 100 c.c., make the solution just alkaline by the cautious addition of 30 per cent. Na_2CO_3; now add 20 c.c.s. of the 30 per cent. NaOH and heat the solution to boiling. When it has reached boiling point add 3 grs. of anhydrous sodium carbonate, stirring the solution meanwhile; allow boiling to continue for about three minutes; remove the beaker from the source of heat and allow the precipitates to settle. Filter by decantation as far as possible, filtering through a 12.5 c.m. paper of the "Whatman No. 1" type, transfer the precipitates to the filter and wash three or four times with hot water, and allow the filtrates to run into a 600 c.c.s. beaker. Reserve this filtrate. Now place the filter paper and precipitate into a 150 c.c. tall-form beaker, add 20 c.c.s. of 50 per cent. HCl and about 0.5 c.c. of HNO_3; heat until all the precipitate is dissolved and the paper thoroughly disintegrated, then dilute to about 70 c.c.s. and boil for two to three minutes; filter off by decantation and wash the pulp well with hot water, twice by decantation and twice after transferring the pulp to the filter paper. The filter paper and pulp may be thrown away, while the filtrate is treated for the separation of the aluminium from the other salts, as before, and filtered, the filtrate being allowed to run into the solution containing the major portion of the aluminium. The double precipitation of the calcium, magnesium, etc., is to ensure that these shall be as free as practically possible from aluminium, some of the latter being usually carried down with the precipitates. Transfer the filter containing the precipitates to a 150 c.c. beaker, add 30 c.c.s. of 50 per cent. HNO_3, and heat to boiling; boil until the whole of the precipitates have dissolved, dilute to about 50 c.c.s. with hot water, then filter through a qualitative paper, wash the filter paper and the paper pulp well; it can then be thrown away. There are now two solutions, one containing the alumina, and the filtrate from the last operation containing the lime, magnesia, iron oxide and

manganous oxide, in the form of salts of these oxides.

Determination of Alumina.

Solutions Required.—Concentrated HCl and HNO_3, conc. NH_4OH, a 50 per cent. solution of NH_4OH, a 2 per cent. solution of NH_4OH.

Procedure.—To the solution containing the alumina add conc. HCl until it is acid, then add about 3 c.c.s. in excess, and also 2 to 3 c.c.s. of conc. HNO_3, heat to boiling, allow the solution to cool a little, now add carefully 50 per cent. NH_4OH until the solution shows signs of becoming alkaline; continue to add NH_4OH until the solution is distinctly alkaline. Too great an excess of ammonia must be avoided, or there is a danger of some of the aluminium hydrate being redissolved. Now heat to boiling, then allow the precipitate to settle; decant through a No. 40-type filter paper of 12.5 cms. as much of the clear solution as possible, add about 100 c.c.s. or hot 2 per cent. NH_4OH to the beaker. Allow the precipitate to settle and decant again, after which transfer it to the filter. The transferring, cleaning of the beaker and washing of the filter and precipitate is done by the aid of the 2 per cent. NH_4OH. Wash the precipitate three or four times; if this is done carefully it will be sufficient to remove any salts from the alumina. Dry the precipitate and paper by placing in an air oven or on the muffle front, then allow the paper to char to ash. To attempt to speed up the estimation by placing the crucible in the muffle immediately after drying is to court trouble, for the sudden burning of the paper and ignition of the residue, especially if they be the least moist, prevents the paper from being completely burned and converted to ash, with the result that a dark grey or even black mass is obtained, which even high temperature blasting will not convert to the white pure alumina, which should be the final condition of the precipitate. A black or grey residue gives abnormally high results as the alumina content.

After the paper has burnt to ash, place the crucible inside the muffle, heat moderately for about ten minutes, then heat at the highest temperature—not less than 900 deg. C.—for 20 to 30 minutes. Remove the crucible to a desiccator to cool and weigh rapidly.

Determination of Manganous Oxide.

Solutions and Reagents Required.—50 per cent. solution of HNO_3; 2.0 per cent. solution of HNO_3; pure sodium bismuthate; standard $N/50$ solutions of potassium permanganate, ferrous ammonium sulphate and sodium oxalate. All three of the latter solutions are best prepared from standardised deci-normal solutions. The purpose of the sodium oxalate solution is for standardising the permanganate.

Procedure.—Transfer the solution containing the calcium, etc., to a 250 c.c.s. calibrated flask—the solution must, of course, be at normal temperature—and dilute to the mark with cold distilled water, shake well to ensure thorough mixing. Pipette 50 c.c.s. of this solution into a 250 c.c.s. conical flask, add 20 c.c.s. of 50 per cent. HNO_3, then one grm. of sodium bismuthate, insert a plain rubber bung in the flask and shake well for two or three minutes. Thorough shaking for some little time aids considerably the conversion of the manganese to permanganic acid, and ensures rapid extraction. After allowing the solution to stand for about 15 to 20 minutes decant the clear liquid off on to a pulp filter, and draw the solution through by the aid of a force pump and filter flask; the latter should have a capacity of about 300 c.c.s. and the pulp should be contained in a filter tube. To the residue in the conical flask add 25 to 30 c.c.s. of 2 per cent. HNO_3, insert the bung and shake again vigorously; then allow it to stand as before. In the meantime wash the pulp once or twice with the 2 per cent. HNO_3. Again decant the liquid on to the pulp, and to ascertain if any manganese remains in the residue add a further quantity of acid; if on shaking and standing the clear solution which settles out does not show any signs of a pink coloration the solution and residue may be thrown away. Wash the pulp with the dilute acid until the washings show no trace of a pink coloration. At this point it is important to note if any bismuthate has percolated through the paper pulp into the filtrate. If the pulp pad shows brown at its base then there is every likelihood that bismuthate has passed through, and it may be sometimes seen floating in the filtrate or settled on the filter flask bottom. In any case, where percolation is suspected refilter the filtrate through a fresh pad, as the presence of bismuthate in the filtrate will render the results hopelessly wrong. Transfer the clear filtrate to a suitable vessel for titrating, and rapidly run into it $N/50$ ferrous ammonium sulphate in excess, that is until the pink colour has been completely destroyed, then add two or three c.c. in excess. Note the total amount used and then carefully titrate the excess of sulphate with the $N/50$ potassium permanganate. Subtract the c.c.s. of permanganate used from the c.c.s. of sulphate solution used; the difference equals the amount of the ferrous ammonium sulphate required to reduce the permanganic acid. Each c.c. so required equals 0.1848 per cent. of manganese on the weight of sample taken, which it will be remembered was a fifth of the original sample weight; that is, 0.10 grm. The factor given is that which applies if the solutions are exactly $N/50$. The manganese per cent. X 1.291 equals manganous oxide per cent. The manganese found in the blank is usually nil or negligible.

(To be continued.)

Catalogues Received.

Pyrometers.—Messrs. Negretti & Zambra, 38, Holborn Viaduct, London, E.C.1, in their List No. T6, describe and illustrate a range of thermometers and pyrometers capable of registering any temperature between 160 and 1,650 deg. C. The range embraces resistance thermometers, base metal thermo-couple, nickel chrome thermo-couple, rare metal thermo-couple, combined thermo-couple and resistance, and portable apparatus. The brochure is printed on art paper, and is well illustrated.

Foundry Equipment.—The catalogue under review was originally prepared by Mr. J. Pickles, whose business has been bought by Messrs. George Green & Company, of Keighley, and to whom we are indebted for its receipt. In the main, it is devoted to moulding machines of the hand-squeeze, turnover variety. These appear to be simple of operation and strongly built. In order to meet the requirements of the jobbing foundry, a setting-out frame has been devised which will take existing patterns if they have a flat back. Reference is made in the catalogue to other well-known types of moulding machines, which breaks an elementary rule in publicity, and we advise its deletion in the next edition. Other specialities which are described and illustrated are a water tumbler, tumbling barrel, a double-ended emery grinder, and sand and loam mills. The catalogue is jacketed in green cardboard, is printed on art paper, and is well illustrated.

Protective Coatings. Messrs. D. Anderson & Son, Limited, of 3, Fenchurch Street, London, E.C.3, have sent us a twelve-page pamphlet dealing with Stablex—a treated bitumen. It is obvious from the catalogue that a good deal of sound research work has been accomplished in testing out this new material, but there is one statement with which we cannot concur. It is said on page 5, wherein tests as to its successful resistance to prolonged immersion in 64 per cent. H_2SO_4, and 25 per cent. HNO_3, and the like are being referred to, that: "It was not practical to determine these tests other than by immersing Stablex on a glass rod, but this is a sufficiently practical method of determining the resisting properties of Stablex against the respective acids mentioned." Surely it would have been better to choose any material other than the very one which by its nature never requires a protective coating. As this is, we believe, an entirely new product, its progress will be watched with interest by the foundry trades, as they require not only weather-resisting protective coatings, but also one which can withstand reasonably elevated temperatures.

The Selling of Castings.—XXX.

BY "VOYAGEUR."

(*Continued from page* 116.)

Inaugurating a Scheme.

The founder who decides to try co-operative selling should choose with discretion a number of other firms whose manufactures have a strong and intimate connection with his own, such as their being consumed under one roof, as in the instance already given. A maker of bedplate castings might co-operate with a machine-tool or crane manufacturer, and rope in a twist drill manufacturer or a chain-maker, and so on. The initiator of the scheme should, above all things, extend his invitation only to firms of capital roughly equal to his own, with selling methods that indicate experience and intelligence. He should write separate and individual letters to each of these, explaining his objects and the advantages of associated selling, and inviting them to attend a meeting convened by him at his own cost.

At this meeting, assuming that he obtains expressions of interest sufficiently strong to justify him in calling it, he should expound his ideas anew. If the meeting is favourably disposed to carry matters a step farther, a committee should be elected from its ranks to examine the overseas marketing arrangements of the consenting firms, and find out if one country can be unanimously agreed upon for the opening of operations. Usually there is at least one in which the various firms are either not represented at all, or are far from being satisfied with their actual representation. The country chosen by the majority should then form the basis for the working out of the scheme.

The next procedure is for the committee to report its progress to a further full meeting of the co-operating firms, who, if they agree to go on, should then appoint special investigators, two being the best number, to journey to the country chosen, study it from the selling standpoint, and try to work out a co-operative selling plan adapted to that country. This plan should be put before the separate firms by the commissioners on their return. Each firm having considered this draft scheme, should then be invited to a final full meeting for the purpose of discussing, modifying, approving or rejecting it. If the scheme is approved, the putting into practice will follow, but here, of course, it is obvious that recommendations must cease, since the succeeding steps would be too particular for a general article of this kind.

Retail Selling.

This series must now conclude with a few remarks upon selling castings to the retail trade. Generally, the larger castings are not sold or distributed through retailers, though from time to time a hardware dealer may book an order for a small lathe or some other machine of technical use that is an embodiment of certain castings. Nevertheless, there are quite a lot of small castings that penetrate into the homes of the ordinary man by way of the retail shop, and a few paragraphs on efficient marketing to the retail trade should not be omitted. Separately taken, individual dealers may not sell many castings in a year, but in the aggregate the retailers of this country sell a handsome number, and the founder should not neglect this outlet for his wares.

Selling castings to the retail trade must have its basis in co-operation. A founder's salesman may succeed in securing a nice order from a retailer for castings; but if he remains satisfied with securing the order he has only robbed himself of repeated orders. In selling to the retail trade, it is the repeat orders that count. In practice, selling to the retail trade involves a dual effort. First, the retailer has to be sold, and then the ordinary customer of the retailer. The retailer will not buy a fresh lot of your castings (whatever character they may have) until he has got the first lot out of his stockroom. Only the founder's willing help can enable him to do this. The founder should, therefore, look upon the retail shop as if it were an essential part of his selling scheme.

In the beginning, the retailer himself must be made to feel that the castings the founder has sold to him are the best he can get. Taking and efficiently filling advertisement space in the papers the retailer reads will do something to ensure this. When advertising to retailers, it must not be forgotten that what appeals to them is not the technical advantages of the casting so much as the extent of the profit they can make on it, the speed with which they can clear it off their shelves, and the amount of trust they can place in it not to lower the reputation of their shops for supplying goods of high quality. Therefore, all advertisements intended for the retailer's eye should stress these points in particular. This applies also to any circulars or literature sent to him.

When the retailer has been interested in the castings, and has been persuaded that it is in his own interests to stock it, two objectives must next be reached. The retailer's assistants must be made to feel that the castings will appeal to the public, and the retailer himself, who usually knows very little about marketing by modern methods, must be assisted in the intensive cultivation of his district so that the largest possible number of purchases of the castings can be obtained from it.

The assistants should be given brightly-written little pamphlets or leaflets, well illustrated, and telling all that it is needful for them to know about the castings, especially what purchasers are likely to want to know about them. With the exception of those who are constitutionally unintelligent, most assistants are glad of information that will make it easier for them to sell goods. But let it never be forgotten that what convinces them most of all is the sight of people coming in to buy.

This sort of conviction can only be won by helping the retailer to get at potential purchasers in his district. Skilled aid in advertising, window-dressing, circularising, and so forth, offered by the manufacturer are invaluable. Good and attractive show-cards and window-stickers will be appreciated. Literature of the appropriate character for inclusion with circular letters to customers, or for free distribution to people in the shop, is another form of service that the retailer will be glad of. Every attempt should be made to persuade him to put the castings in his window prominently.

A good way to do this is to give him a clever window-decoration scheme, suitable for all his goods, but including the castings in a favourable position. The founder should offer to superintend the execution of this window-design free of charge, if he is competent to do so. Another good plan, if the castings allow of it, is to arrange demonstrations in the shop.

Naturally, the founder whose castings are only casually sold through retail shops, will hardly care to embark upon efforts and expenses of this kind. As a general rule it is needless for him to do so, since his direct sales to the consumer will probably be sufficiently large for his immediate needs. But the maker of castings that depend upon the retailer for their sale will find it indispensable to co-operate with him in attracting public notice to the goods.

Besides lending the retailer blocks for his advertising, and giving the service outlined above, the founder will also have to advertise widely himself. In his announcements, he will find it an advantage, and a great inducement to the retailer to buy, if he includes where possible a list of the retailers in a particular district who stock his castings. This, besides pleasing the retailer, is a convenience to potential purchasers.

Concluding Remarks.

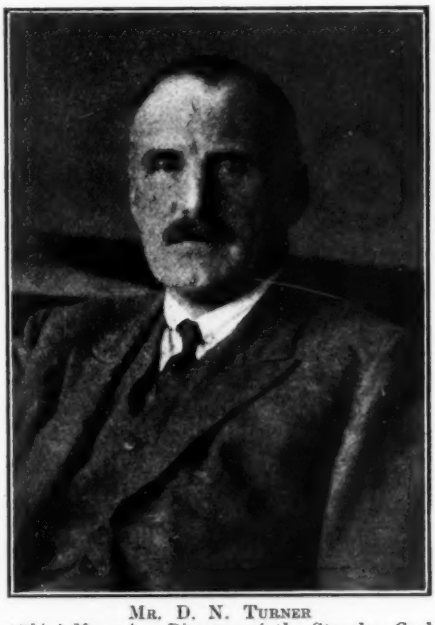
This series must not be regarded as an attempt to cover every possible phase of selling castings. Many of the articles of which it is composed could be expanded into separate books, each as long as the series now concluding. Broad treatment has been given to each phase of selling, and the articles should be considered as a preliminary examination of the selling problems confronting the founder, not as complete treatises. At the same time, within these limits, the writer does believe the series to have given a clear and ordered indication of the problems to be solved and the methods to be adopted in establishing and maintaining a sound selling scheme. Individual founders can follow with safety most of the general recommendations given, adapting these to their specific needs.

XUM

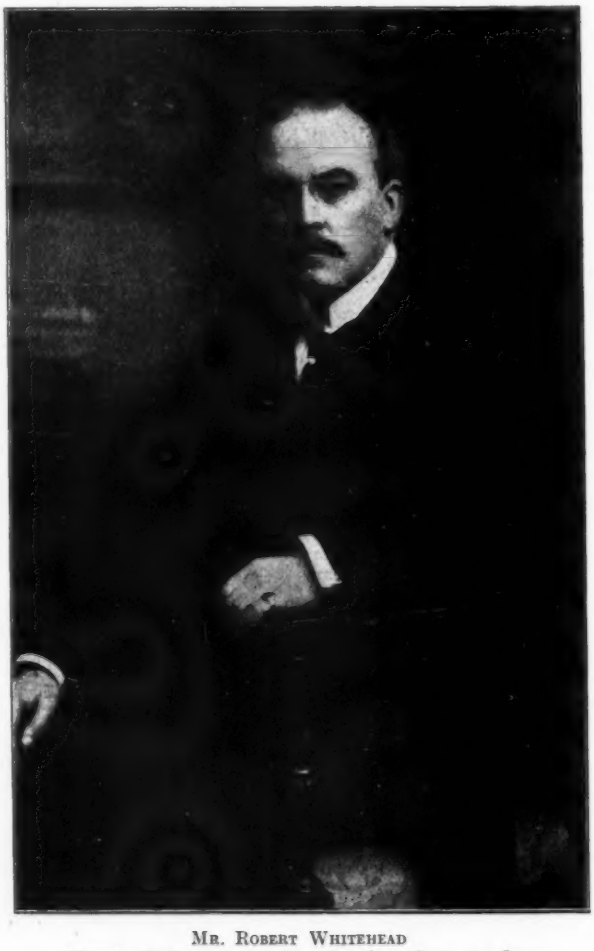
Staveley Co.'s New Appointments.

SIR WM. BIRD, J.P., who, as we have already announced, has been elected chairman of the Staveley Coal & Iron Company, Limited, near Chesterfield, is chairman of the Dalmellington Iron Company, Limited, a position which he has held since 1913. He has also been a director of Williams Deacons Bank for twenty years, while he is a director of the Parkgate Iron & Steel Company, Limited, of many years standing. Sir Wm. Bird, who resides at Eartham, Chichester, was Master of the City Guild of the Saddlers Company in the year 1919-20, and has been

SIR WM. BIRD
(Chairman of the Staveley Coal & Iron Company, Limited.)



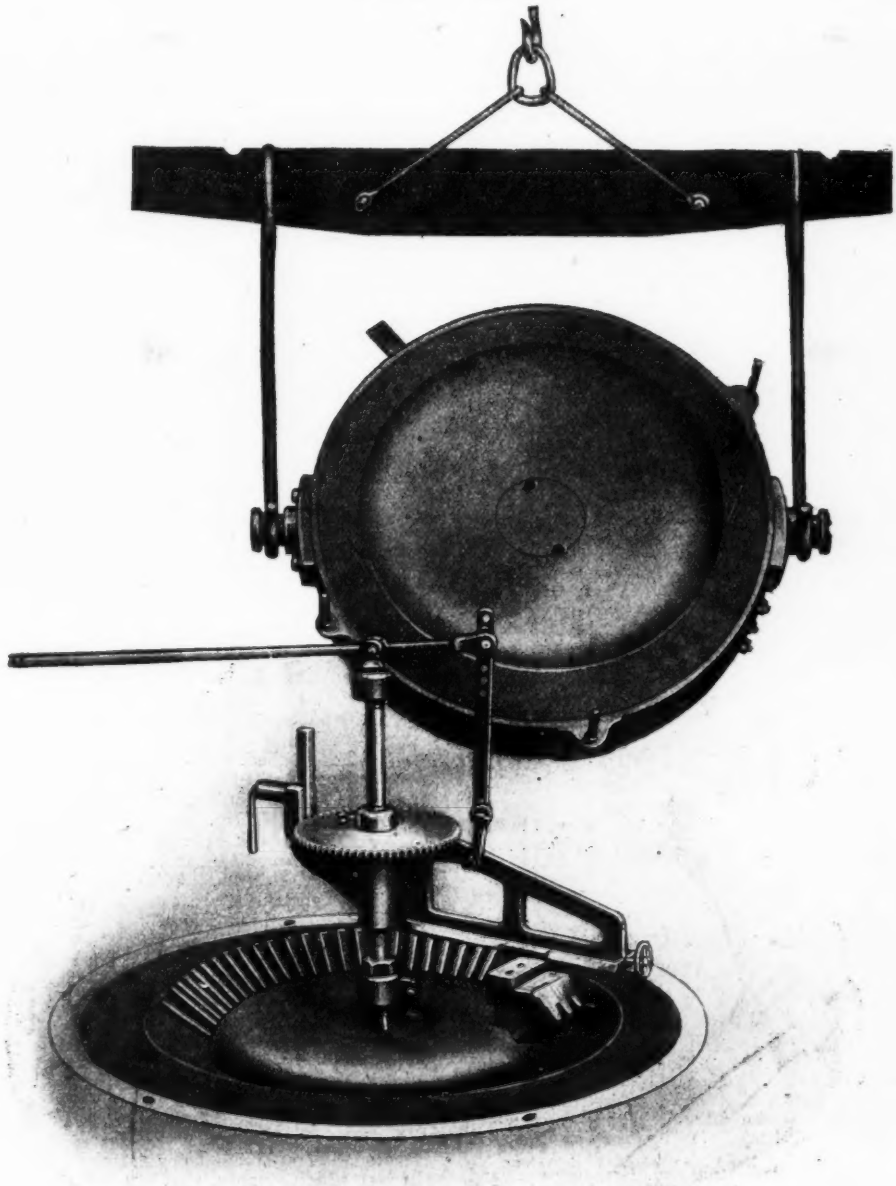
MR. D. N. TURNER
(Chief Managing Director of the Staveley Coal & Iron Company, Limited.)



MR. ROBERT WHITEHEAD
(Deputy-Chairman of the Staveley Coal & Iron Company, Limited.)

The "VULCANIA" PATENT WHEEL MOULDING MACHINE.

Patent No. 5049.



THE "VULCANIA" PATENT WHEEL MOULDING MACHINE is for moulding spur wheels with straight, sloping or Vee-shaped teeth, also bevel wheels, skew gear wheels, worm wheels and internal wheels. The machine head is carried on a pillar which is held in a base-plate bedded in the floor sand, and is made to slide on the pillar by means of a lever and link carried on a joint bearing, or by rack and pinion, or screw if thought advisable for the particular work it is being used for.

An adjustable stop collar is provided for accurately deciding the depth of mould. On the removable head a slide is carried for supporting the patterns of the teeth to be moulded. This slide is made adjustable by screw or pinion gearing to the diameter required. The number of teeth to be moulded is decided by a special dividing plate into which a steel wedge or finger engages. The special dividing plate has milled vees, at the angle of 60° inclusive, around its circumference, to receive the steel wedge, which is adjusted by a screw having an internal spring to keep it in tension and to lock the head when ramming operations are being carried out.

JAMES EVANS & CO., BRITANNIA WORKS,
(MANCHESTER), LIMITED,
BLACKFRIARS, MANCHESTER.

a member of the Court since 1913. He is the principal of a firm of solicitors in the Gray's Inn, the title of the firm being Bird & Bird.

Mr. D. N. Turner, of Walton Lodge, Chesterfield, who has been elected principal managing director, was educated at Sedbergh School. He is a member of the Institution of Mining Engineers, a Fellow of the Surveyors' Institution, a Fellow of the Geographical Society, an Official Referee of the Reference Committee of England, and J.P. for the County of Derby. He was an articled pupil to the late Mr. John Hewitt, of Hewitt & Robart, mining engineers, Derby, in 1890, and eight years later became a partner in the firm of Coke, Turner & Company, mining engineers. For several years he was sole principal of this firm, and as such was mineral agent for several large estates, such as the Duke of Rutland, the Duke of Newcastle, Lord Scarborough, Lord Desborough, Lord Yarborough, St. Thomas' Hospital, St. John's College, and many others. In 1920 he was appointed agent for the collieries of the Staveley Coal & Iron Company, Limited, with an annual output of two and a-half million tons. In 1924 he was elected a managing director of the Staveley Company, and general manager of their collieries. In addition he is deputy chairman of Markham & Company, Limited, and a director of the Bullcroft Main Colliery Company, Limited, the Brodsworth Main Colliery, Company, Limited, the Yorkshire Main Colliery Company, Limited, and other companies.

Mr. Robert Whitehead, who has accepted the position of deputy chairman, is by profession a stockbroker, and also farms approximately 600 acres of land, being a member of the Advisory Committee on the Board of Agriculture. He is an ex-High Sheriff of Derbyshire, and has travelled extensively, going round the world in 1880. He was privately educated, subsequently studying in Brussels, and at the Manchester University under Dr. Roscoe. He also took a course at the Royal Agricultural College, where he obtained his diploma. He has in turn been interested as a manager of dyeworks, also in the India-China shipping trade. His directorates include the following:—Senior member of the Board of the Staveley Coal and Iron Company, Limited, where his father was an original director; senior member of Cammell, Laird & Company, Limited, and a director of the Leeds Forge Company, Limited, the Newlay Wheel Company, Limited, the Midland Railway Carriage and Wagon Company, Limited, the Firbeck Collieries, Limited, the Newstead Colliery Company, Limited, the Brodsworth Main Colliery Company, Limited, the Yorkshire Main Colliery Company, Limited, the Doncaster Collieries Association, Limited, the Bristol Wagon Company, Limited, and others.

Safeguarding the Manufacture of Tungsten.

Extension Recommended.

The report was issued last week of the Committee appointed by the Board of Trade to inquire into the effect of Part I of the Safeguarding of Industries Act, 1921, on the development of the industries manufacturing under the Act, and the desirability or otherwise of an extension of the Act after its expiry on August 19 next.

Dealing with metallic tungsten, ferro-tungsten, and manufactured products of metallic tungsten, the report says that in 1923, even with the safeguarding duty, it was with difficulty that the competition in tungsten could be met. To avoid obtaining supplies from the Continent it was decided to re-open the largest of the factories used during the war in the manufacture of tungsten. Since that time the total annual production of tungsten and ferro-tungsten by the several firms now engaged in the manufacture has increased year by year. It has thereby proved possible to manufacture other ferro-alloys also on a commercial basis, and, owing to the high quality of the British products, even to make sales of these and of ferro-tungsten to the Continent in competition with foreign makers.

Continuing, the report says:—"We are of opinion, having regard to what has been already said of the great importance of the industry, that the manufacture of tungsten and ferro-tungsten and of products of metallic tungsten should continue to be safeguarded for a further period of years until conditions are more normal and the British industry has become firmly established."

The Stroud Metal Company, Limited, are being wound up voluntarily, and Mr. L. Dudbridge is liquidator.

Explosion Hazards from Pulverised Coal.

Since natural gas production has declined near a number of the large industrial centres in the United States, pulverised coal has been largely adopted as a substitute, particularly in those cases where a steadily intense heat is required. It has been introduced in the steel industry as a fuel for sheet furnaces, billet furnaces, and small forge furnaces, whilst it is also being used in the large smelters, mainly reverberatory plants.

Unfortunately, there have been several fires and explosions, whereby operatives have been killed and property damaged in plants using this fuel, so the United States Bureau of Mines has taken the opportunity of making a study of the conditions under which such disasters have occurred, and the result of this study has been the issue of a bulletin containing safety rules.

In this it is set out that the principal constituents of coal that have a direct bearing on the explosibility of coal dust are moisture, volatile matter, fixed carbon, and ash. Fineness is the physical characteristic that governs the explosibility of pulverised coal. In itself it is not explosive in bulk, and becomes dangerous only when stirred up into a cloud with the proper proportion of air, and brought in contact with an open flame or a body having a temperature high enough to ignite it.

To reduce the explosion hazard, there should be absolute cleanliness and freedom from any accumulations of dust, both in the pulverising plant and in the buildings in which the pulverised coal is used as fuel. Accumulations of dust on the floor or machinery should never be brushed or swept up without either the dust being wetted or thoroughly mixed with an excess mixture of fine incombustible material.

All coal-pulverising plants should be adequately ventilated and lighted, and, when practicable, some method of cleaning by vacuum system should be installed. All open lights in and around coal-pulverising plants should be prohibited, and operatives should not be allowed to smoke while in the building.

The drier and drier furnace should be separated by a fireproof partition from the pulverising mills, conveying machinery, and storage bins. Where furnaces and boilers are equipped with individual fuel bins, these bins, if possible, should be isolated from the boilers or furnaces. All pulverised coal bins should be tightly closed, and never opened if there is any possibility of ignition from an open flame. Bins should be equipped with automatic indicators to indicate the amount of coal in the bin.

Especial care should be taken not to overheat the coal in the drier, and recording pyrometers should be installed to enable the officials of the plant to check the operation of the drier. The latter should never cease while a charge of coal is being treated. Fire in the drier furnace should never be started with paper, shavings, or any light combustible material. Because of the liability to spontaneous combustion, dried or pulverised coal at a temperature over 65 deg. C. should never be stored in a bin for more than eighteen hours. Whenever a plant has to be shut down for a few days all storage bins should, if possible, be emptied of coal. Whenever pulverised coal becomes caked in bins, transport lines, or conveyors, it should not be jarred off by hammering, because of the liability of causing leaking joints.

A coal-line compressed air tank, or storage bin, should never be opened in the vicinity of a flame or open light. All electric cables and wires should, as far as possible, be enclosed in conduits, preferably of rigid iron. All switches should be placed outside the pulverising plant or in dust-proof casings. Precautions should be taken against sparks from static electricity in all rapidly-moving machinery by having it thoroughly grounded. Dust should never be allowed to accumulate upon electric light bulbs, and the bulbs of all portable lights should be protected by heavy wire guards. Care should be taken to prevent arcing from loose socket connections or imperfectly insulated cords.

Sterling

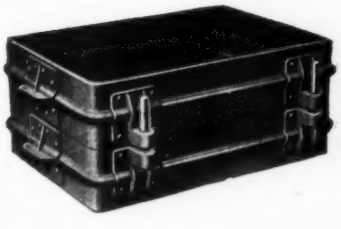
Lightness and ease of handling, robust construction, accuracy and durability are the paramount essentials of the modern Moulding Box.

These qualities are solidly built into all STERLING ROLLED STEEL BOXES.

ROLLED STEEL

means lightness combined with strength, durability and permanent accuracy.

Some of the largest and most up-to-date Foundries in the country are now completely equipped with STERLING BOXES. If you are not already a Sterling user investigate the matter without delay.



STERLING FOUNDRY SPECIALTIES LTD.
BEDFORD

London Office: 13, VICTORIA STREET, S.W.1.

Trade Talk.

THE MEMBERS of the Walsall Engineering Society last week paid a visit to the works of the General Electric Company, Limited, at Birmingham.

SIR HUGH BELL and Lady Bell have been presented with a gold cup, in celebration of their golden wedding on August 10, by the tenants and employees on their estates.

LIGHTALLOYS, LIMITED, announce that in future the whole of their business will be carried on from St. Leonard's Road, Willesden Junction, London, N.W.10.

THE ELBA STEELWORKS, Gowerton, Swansea, of Baldwins, Limited, have been restarted, the boiler plant having been converted to use oil in the place of coal.

THE TRIUMPH STOKER, LIMITED, report the receipt of contracts for forced draught self-cleaning furnaces, and mechanical stokers for Lancashire boilers for the Crumlin Valley Collieries, Limited, and Leeds Board of Guardians.

THE Grinding and Pulverising Offices of International Combustion, Limited, 11, Southampton Row, report the sale of five Hardinge conical ball mills, three Raymond pulverisers, two Raymond separating plants, and two Hum-mer electric screens.

ALFRED HERBERT, LIMITED, of Coventry, propose, as soon as the necessary accommodation becomes available, to concentrate the whole of their establishment, both productive and administrative, on a site of about 30 acres adjoining their present works at Edgewick.

IMPORTS OF FOREIGN COAL have permitted a resumption of activities at the Hawarden Bridge Ironworks, near Chester, owned by John Summers & Sons, Limited. The company have been able gradually to re-absorb five thousand men who previously were unemployed.

RD. JOHNSON, CLAPHAM & MORRIS, LIMITED, have just been appointed sole agents in the North of England and North Wales for Armco ingot iron in black, galvanised (flat and corrugated), bright tinned and leadcoated sheets, and will keep stocks at their warehouses, Jacem House, Trafford Park, Manchester.

THERMIT, LIMITED, a constituent company of Nobel Industries, Limited, are transferring their works from Church Road, Battersea, to more commodious premises at Angel Road, Edmonton, London, N. Thermit, Limited, also carry on the business of the late Continuous Reaction Company, Limited, of Newton Works, Hyde, Cheshire, and will in future manufacture at their Edmonton works the "Concreacto" brand of ferro-tungsten and other metals and alloys.

THE GATES to the Wet Dock at Ayr have not been used for many years, and the London Midland and Scottish Railway Company have decided to remove them and to take away the cill, which is 3 ft. above the bottom of the Dock. Work was commenced on June 30, and, when completed, the depth of the water at the Dock entrance will be increased by 3 ft., giving 22 ft. and 15 ft. at high and low water respectively, thus affording accommodation for larger vessels than hitherto have been able to use the docks.

Contracts Open.

Barwick-in-Elmet, August 14.—Providing and laying about 280 yards of 4-in. cast-iron water mains, with valves, hydrants, etc., for the Tadcaster Rural District Council. Mr. E. Thackray, water inspector, Station Road, Kippax.

Hebden Bridge, August 17.—(a) Supply and delivery of 243 yards of 4-in. cast-iron water pipes, etc., for the Urban District Council. Mr. H. L. Bottomley, waterworks manager, Council Offices, Hebden Bridge.

London, S.E.1, August 13-20.—The Director-General, India Store Department, Branch No. 14, Belvedere Road, Lambeth, S.E.1, requires: (1) 25,000 yards of solid mild-steel point rodding; (2) 22,500 steel boiler tubes for locomotives; (3) 30,000 cast-iron pot sleepers, with gibs and cotters; (4) 815 laminated bearing and elliptical springs for railway stock; (9) 148 tons mild-steel rivets, black; (10) 210 tons galvanised mild-steel strand wire for fencing; (11) 117 cwt. crucible cast high-speed tool steel; (12) 1,360 tons mild-steel bars (rounds, rods, angles, flats and squares); (13) 1,000 6-in. cast-iron pipes and 1,000 "Victaulic" joints; (14) crossings and switches and spare parts; (15) 23 tons brass angles, strips, bolt and sheets; (16) 74 tons copper rods (not extruded) and copper tubes. (Fee, 5s. per set, non-returnable.) Tenders due on August 13 for Nos. 1 and 2, on August 17 for Nos. 3 and 4, and August 20 for Nos. 9 to 16.

Auckland, N.Z., September 27.—One 14-ton electrically-operated crane, for the Auckland Electric Power Board. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Ref. A.X. 3415.)

Company Reports.

W. & T. Avery, Limited.—SIR J. FORTESCUE FLANNERY occupied the chair at the annual meeting of W. & T. Avery, held at Birmingham. In proposing the adoption of the report, the chairman pointed out that the financial year which closed in March was one of disaster for many companies in the iron and engineering trades, but, through the loyalty of that firm's customers, workers, and staff, and by careful management and administration, they had emerged practically unscathed, and with a satisfactory result of the year's operations. He paid a tribute to the managing director, Mr. Gilbert Vyle, and congratulated him on behalf of the shareholders upon his election as president of the Association of British Chambers of Commerce. The firm were constantly endeavouring to broaden the base of their operations by opening up new markets and by increasing the range and variety of their products. Recently their sales at home had been materially affected, but they had to a considerable extent balanced that by increased business abroad. The current year had opened under very adverse conditions, but they were not discouraged, and were looking forward with hope and confidence.

Petters, Limited.—The sixteenth annual meeting has been held at the offices of the company at Yeovil. SIR ERNEST W. PETTER (the chairman) presided. The chairman, in moving the adoption of the report and accounts, said:—As I said in my speech last year, I feel that British industry and industrial workers have grave cause to complain of the action of the present and preceding post-war Governments, which have followed a financial and not an industrial policy. I do not say that in the long run there is any inherent antagonism between these two interests, but the admitted policy of our Governments has been to place financial interests in the forefront and to ignore the effect of so doing upon industrial interests. As a result, we still have the wage anomalies to which I referred last year, and higher wages are still being paid to workers in so-called sheltered occupations than to workers possessing greater skill engaged in industries vital to the country which are exposed to the blast of foreign competition. The result is that we have throughout the country a wave of discontent and dissatisfaction with their lot amongst industrial workers, which, in my opinion, is quite natural, and employers are blamed for maintaining low wages notwithstanding that they are working under conditions which they are powerless to alter. It cannot be right that in a country dependent upon its exporting industries these industries should be languishing and their workers under-employed and under-paid, while people whose interests are financial and merchanting are reaping rich harvests, and workers in non-exporting occupations are relatively over-paid. There are two things at least which the Government ought to do in this time of emergency. They ought to see to it that our home needs are supplied as far as practicable from home factories, because in the first instance every import of manufactured goods cancels an export of equal value; and, further, seeing that cost of production in any highly organised factory is in strict relation to quantity of output, every import of a manufactured article capable of being manufactured at home tends to raise the cost of production in our establishments and makes export competition more difficult to meet. Secondly, they should find means at once of ridding the country of the foreign influences which admittedly have for their object the destruction of our industries and which, during this summer, have gone a long way towards achieving their aim.

Applications for Trade Marks.

The following applications to register trade marks are extracted from the "Trade Marks Journal":—

"SPEARIOR."—Cutlery and edge tools. Spear & Jackson, Limited, Aetna Works, Savile Street East, Sheffield.

"BALFOSTEEL."—Edge tools. Arthur Balfour & Company, Limited, Capital Steel Works, Willey Street, Sheffield.

Wills.

BATES, A., Winsford, Cheshire, head of James Bates & Sons, ironfounders ...	£6,071
ROBERTS, SIR SAMUEL, BART., of Queen's Tower, Sheffield	£384,562
WILLCOCKS, H. S., of Red Lodge, Hale, Cheshire, founder of H. S. Willcocks, Limited, of Manchester, chemical and metal merchants	£18,051

'CLEVELAND'

PNEUMATIC TOOLS FOR FOUNDRIES

SAND RAMMERS

CHIPPING HAMMERS

PORTABLE GRINDERS

'BOWES' instantaneous hose COUPLINGS

'CLECO' air-tight pressure-seated VALVES

'CLECO' BLOW GUNS

VIBRATORS

Write for Catalogue 25.

JOHN MACDONALD & CO.,
POLLOKSHAWS,
GLASGOW.

Don't Scrap Castings

because of surface defects—

DO AS THE BEST FOUNDRIES DO AND APPLY

FERRUM CEMENTS

FERRUM CEMENT M6 is specially made for Foundry use. It sets very quickly, is metallic, and when set becomes part of the casting itself. It can be filed like iron.

FERRUM CEMENT No. 2 is slower setting but extremely hard and metallic.

The QUALITY of FERRUM CEMENTS is proved by the ever-increasing sales during the past 20 years.

Literature and free sample tins from the sole manufacturers:

THE AMALGAMS CO., Ltd.
186, Attercliffe Road, Sheffield.

Use Ferrum Cements

WELLMAN CRANES

10-ton Electric Overhead Travelling Crane, operating in a Foundry.

Illustrated Catalogues sent on request.

THE WELLMAN SMITH OWEN ENG. CORP., LTD.

Telephones: HOLBORN 2588/9.

36-38, Kingsway, LONDON, W.C.2.
Works - - DARLASTON, South Staffs.

Telegrams: "Principium, Westcent, London."

IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—In the prevailing conditions in the Cleveland iron market week by week, it becomes increasingly difficult to entertain even the slenderest optimistic views of the position as regards the future prospects of the industry, now experiencing the most serious setback of post-war times. Not only are markets stagnant, a by no means unusual occurrence of late, but furnace production has been reduced to absolutely negligible dimensions, there being at the moment only four plants in blast in the whole of the North-East area. Of these, two are on Cleveland iron, and two on hematite. Even when the crisis is over, it will take weeks to get back to the normal. Hence, it is not at all improbable that present conditions may continue until the end of September. Meantime, the quantities of iron available for consumers are at a minimum, and those in urgent need have to pay no less than 90s. per ton for the standard No. 3 G.M.B. Quotations for other qualities are:—No. 1, 92s. 6d.; No. 4 foundry, 89s.; and No. 4 forge, 88s. 6d. per ton.

There are still plentiful supplies of hematite available on Tees-side, though there has recently been a rather better inquiry from some of the foundries in consequence of the scarcity of foundry iron. Occasional lots, moreover, are still being exported.

Metals.

Copper.—The market for standard copper remains steady, the position being considerably strengthened by the support lately evidenced in the American buying movement. An improvement in Germany is also noticed, and this, combined with the movement in America, has been responsible for large lines being persistently absorbed by leading interests, and, consequently, values have advanced substantially.

Stocks in metal exchange warehouses in the U.K. at the end of June:—Refined, 3,748 tons; rough, 47,219 tons; total, 50,967 tons. In U.S.A. (electrolytic), 59,014 tons; in U.S.A. (blister), 237,905 tons; in Havre, 11,670 tons.

Official closing prices of standard copper have been as follow :—

Cash: Thursday, £59 to £59 2s. 6d.; Friday, £58 12s. 6d. to £58 15s; Monday, £58 15s. to £58 17s. 6d.; Tuesday, £59 to £59 2s. 6d.; Wednesday, £58 15s. to £58 17s. 6d.

Three Months: Thursday, £59 17s. 6d. to £60; Friday, £59 7s. 6d. to £59 10s.; Monday, £59 10s. to £59 12s. 6d.; Tuesday, £59 15s. to £59 17s. 6d.; Wednesday, £59 10s. to £59 12s. 6d.

Tin.—A summary of the statistical position for June affords emphatic evidence of the favourable position of standard metal, both at home and in the world's markets, and will explain the steady advance in values which almost daily brings the figures nearer to the £300 level. That the position is becoming serious is indicated by another sharp drop in tin stocks, such low records not having been seen for a very long time, and there is thus rather a nervous feeling on the part of consumers in regard to the filling of their future requirements.

Official closing prices of standard tin have been as under :—

Cash: Thursday, £295 5s. to £295 10s.; Friday, £296 5s. to £296 7s. 6d.; Monday, £298 10s. to £298 12s. 6d.; Tuesday, £297 15s. to £298; Wednesday, £294 to £294 5s.

Three Months: Thursday, £288 to £288 5s.; Friday, £288 15s. to £289; Monday, £290 10s. to £290 12s. 6d.; Tuesday, £290 10s. to £290 15s.; Wednesday, £287 5s. to £287 10s.

Spelter.—As an exception to the general rule, more stocks of ordinary brands of zinc are available for near delivery than required, and this has kept the prompt value at a moderate discount, but reports about the position in the Continental and American markets are rather more hopeful. A fairly active business has been transacted; on the whole, buyers have evinced rather more interest, and demand on the part of consumers in this country still inclines to improve.

The following are the week's prices :—

Ordinary: Thursday, £34 5s.; Friday, £34; Monday, £33 18s. 9d.; Tuesday, £34 6s. 3d.; Wednesday, £34 6s. 3d.

Lead.—The market for soft foreign pig remains practically stationary, and without outstanding features of interest. World production in June can be assumed at between 125,000 tons and 130,000 tons, so that the output for 1926 is unlikely to reveal any great increase on last year's production unless the monthly returns between now and December are heavier than in the first six months.

The week's prices are appended :—

Soft foreign (prompt): Thursday, £33; Friday, £32 10s.; Monday, £32 17s. 6d.; Tuesday, £33 2s. 6d.; Wednesday, £32 16s. 3d.

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
Works: HALLSIDE, NEWTON and BLOCHAIRN, GLASGOW.

CONTRACTORS TO HOME, COLONIAL AND FOREIGN GOVERNMENTS.

Established 1872. *Telegraphic Address: "Steel, Glasgow."*

GANISTER, CUPOLA BLOCKS, FIRE BRICKS,
FIRE CLAY.

Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.

STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.
DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

If it's REFRACTORY MATERIAL you require, use

CUPOLINE

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the ideal material for Cupolas, Ladles, Converters, Soaking Pits, O.H. Furnace Doors, Electric Furnaces, Gas Retorts, Boiler Settings, etc., etc.

Please Phone, Wire or Write:

ROBSON REFRACTORIES LTD.

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DARLINGTON, Durham.

Telephone: 2405. *Telegrams: Cupoline, Darlington.*

CUPOLINE STORAGE DEPOTS AT:

Middlesbrough, Leith, Newcastle-on-Tyne, Newport (Mon.), Garston, Liverpool.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash ..	58	15	0
Three months ..	59	10	0
Electrolytic	67	0	0
Tough	65	0	0
Best selected ..	65	15	0
Sheets	90	0	0
India	74	0	0
Wire bars	67	10	0
Do. August ..	67	5	0
Do. Sept.	67	5	0
Ingot bars	67	5	0
H.C. wire rods ..	71	5	0
Off. av. cash, July	57	18	6 3/11
Do., 3 mths. July	58	13	11 8/11
Do., Sttlmnt, July	57	17	11 5/11
Do., Electro, July	65	17	0 5/11
Do., B.S., July ..	64	0	10
Aver. spot price copper, July ..	57	17	11½
Do., wire bars, July	66	1	7
Solid drawn tubes			13d.
Brazed tubes ..			13d.
Wire			9¾d.

BRASS.

Solid drawn tubes ..	12d.
Brazed tubes	13½d.
Rods, drawn	11½d.
Rods, extd. or rlld. ..	7½d.
Sheets to 10 w.g ..	10½d.
Wire	10½d.
Rolled metal	9⅞d.
Yellow metal rods ..	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets ..	8½d.

TIN.

	£	s.	d.
Standard cash ..	294	0	0
Three months ..	287	5	0
English	292	10	0
Bars	298	5	0
Straits	305	15	0
Australian		—	
Eastern	297	0	0
Banca		—	
Off.avr. cash, July	282	3	11 1/22
Do.,3 mths., July	280	5	9 9/11
Do., Sttlmt. July	282	2	11 5/11
Aver. spot., July	282	3	11

SPELTER.

	£	s.	d.
Ordinary	34	6	3
Remelted	33	10	0
Hard	29	0	0
Electro 99.9 ..	37	10	0
English	34	17	6
India	31	5	0
Zinc dust	43	0	0
Zinc ashes	16	0	0
Off. aver., July	34	3	1 17/20
Aver., spot, July	33	0	11

LEAD.

	£	s.	d.
Soft foreign ppt.	32	16	3
English	34	5	0
Off. average, July	31	12	7 1/11
Average spot, July	31	14	3¾

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	42	0	0
Do. V.M. ex whf.	39	10	0
Rods	44	0	0
Boiler plates ..	38	10	0
Battery plates ..	38	0	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	74	10	0
Chinese	65	0	0
Crude	45	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver ..	15	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon	
25%	9 3 0
45/50%	11 0 0
75%	18 0 0
Ferro-vanadium—	
35/40% ..	15/- lb. va.
Ferro-molybdenum—	
70/75% c. free ..	5/6 lb.
Ferro-titanium—	
23/25 carbonless	11½d.
Ferro-phosphorus, 20/25%,	£17 0 0
Ferro-tungsten—	
80/85%, c.fr. ..	1/4½ lb.
Tungsten metal powder—	
98/99% ..	1/10½ lb.
Ferro-chrome—	
2/4% car. ..	£33 10 0
4/6% car. ..	£22 0 0
6/8% car. ..	£21 10 0
8/10% car. ..	£20 15 0
Ferro-chrome—	
Max. 2% car.	£37 0 0
Max. 1% car.	£43 10 0
Max. 0.70% car.	£54 10 0
70%, carbonless	1/5½ lb.
Nickel—99%, cubes or pellets ..	£170
Cobalt metal—98/99%	10/- lb.
Aluminium 98/99%	£118
Metallic Chromium—	
96/98% ..	3/3 lb.
Ferro-manganese (net)—	
76/80%, loose	£14 0 0
76/80%, packed	£15 0 0
76/80%, export	£14 0 0
Metallic manganese—	
94/96%, carbonless	2/- lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten ..	2	6
Finished bars, 18% tungsten ..	3	0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. and over .. 4d. lb.

Rounds and squares under ½ in. to ¼ in. 3d. lb.

Do. under ¼in. to 1/16 in. .. .. 1/- lb.

Flats, ½in. × ¼in. to under 1 in. × ⅛ in. 3d. lb.

Do. under ½in. × ¼in. 1/- lb

Bevels of approved sizes and sections 6d. lb.

Bars cut to length 10% extra

Scrap from high-speed tool steel—

Scrap pieces .. .. 3d.

Turnings and swarf 1d.

Per lb. net, d/d steel makers' works.

SCRAP.

South Wales—	£	s.	d.	£	s.	d.
Hvy. steel	2 10 0	to	2	15	0	
Bundled steel & shrngs.	2 0 0	to	2	5	0	
Mixed iron & steel ..	2 0 0	to	2	5	0	
Heavy cast iron	3	0	0			
Good machinery for foundries ..	3	5	0			
Cleveland—						
Heavy steel ..	3	1	0			
Steel turnings ..	2	6	0			
Cast iron borings	2	5	0			
Heavy forge ..	4	2	6			
Bushelled scrap	3	10	0			
Cast-iron scrap	3	8	0	to 3	10	0
Lancashire—						
Cast-iron scrap	3	2	6	to 3	10	0
Hvy. wrought ..	3	2	6			
Steel turnings ..	2	2	0			
London — Merchants' buying prices delivered yard.						
Copper (clean)..	49	0	0			
Brass (clean) ..	39	0	0			
Lead (less usual draft)	28	10	0			
Tea lead ..	24	10	0			
Zinc	24	0	0			
New aluminium cuttings ..	80	0	0			
Braziery copper	45	0	0			
Gunmetal ..	46	0	0			
Hollow pewter	195	0	0			
Shaped black pewter ..	142	0	0			

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast—	
Foundry No. 1 ..	92/6
Foundry No. 3 ..	90/-
Foundry No. 4 ..	89/-
Forge No. 4	88/6
Hematite No. 1 ..	81/6
Hematite M/Nos. ..	81/-
N.W. Coast—	
Hem. M/Nos. d/d Glas.	87/6
„ d/d Birm.	98/9
Midlands—	
Staffs. common* ..	—
„ No. 4 forge ..	—
„ No. 3 foundry	—
Shrops. basic	—
„ Cold blast, ord.*	—
„ „ roll iron* ..	—
* d/d Birmingham.	
Northants forge	—
„ fdry No. 3 ..	—
Derbyshire forge ..	—
„ fdry. No. 3 ..	—
„ basic	—
Scotland—	
Foundry No. 1 ..	—
„ No. 3 ..	86/9
Hem. M/Nos.	79/-
Sheffield (d/d district)—	
Derby forge	—
„ fdry. No. 3 ..	—
Lincs. forge	—
„ fdry. No. 3 ..	—
E.C. hematite	93/-
W.C. hematite ..	91/6
Lincs. (at furnaces)—	
Forge No. 4	—
Foundry No. 3.. ..	—
Basic	—
Lancashire (d/d eq. Man.)—	
Derby forge	—
„ fdry. No. 3 ..	—
Northants foundry No. 3	—
Dalzell, No. 3	110/-
Summerlee, No. 3 ..	102/6
Glengarnock, No. 3 ..	102/6
Gartsherrie, No. 3 ..	102/6
Monkland No. 3	102/6
Coltness, No. 3	102/6
Shotts, No. 3	102/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars(cr.)	11 5	0	to	12	0	0
Angles				11	10	0
Tees to 3 united ins.				12	0	0
Nut and bolt	10 5	0	to	10	7	6
Hoops	14 0	0	to	15	0	0
Marked bars (Staffs.) f.o.t. ..				14	0	0
Gas strip				12	10	0
Bolts and nuts ¾ in. × 4 in. ..				15	5	0
Steel—						
Ship plates				8	2	6
Boiler plts. ..				11	5	0
Chequer plts. ..				9	10	0
Angles				7	7	6
Tees				8	7	6
Joists				7	7	6
Rounds and Squares 3 in. to 5½ ins. ..				9	0	0
Rounds under 3 in. to ¾ in.				8	15	0
Flats, over 5 in. wide and up ..				9	10	0
Flats, 5in. to 1½in.				8	10	0
Rails, heavy ..				8	0	0
Fishplates				12	0	0
Hoops (Staffs.) ..				10	10	0
Black sheets, 24g.				11	2	6
Galv. cor. sheets, 24g.				17	0	0
Galv. fencing wire 8g. plain				12	10	0
Billets, soft ..				6	10	0
Billets, hard ..				8	2	6
Sheet bars				6	5	0
Tin bars d/d ..				6	5	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	3¾
Rods	1	3
Tubes	1	8
Castings	1	2

Delivery 3 cwt. free

10% phos. cop. £40 above B.S.

15% phos. cop. £50 above B.S.

Phosphor tin (5%) £30 above price of English ingots.

C. Clifford & Son, Limited.

NICKEL SILVER, &c.

Per lb.

Ingots for raising 9d. to 1/3

Rolled—

To 9 in. wide 1/3 to 1/9

To 12 in. wide 1/3½ to 1/9½

To 15 in. wide 1/3½ to 1/9½

To 18 in. wide 1/4 to 1/10

To 21 in. wide 1/4½ to 1/10½

To 25 in. wide 1/5 to 1/11

Ingots for spoons and forks .. 9d. to 1/5½

Ingots rolled to spoon size .. 1/- to 1/8½

Wire round—

3/0 to 10 G. 1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	22.26
No. 2 foundry, Valley	19.26
No. 2 foundry, Birm.	21.00
Basic	19.26
Bessemer	20.26
Malleable	19.51
Grey forge	18.76
Ferro-mang. 80% d/d	88.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars ..	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila. ..	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	2.00
Skelp, grooved steel ..	1.90
Skelp, sheared steel ..	1.90
Steel hoops	2.50
Sheets, black, No. 28..	3.10
Sheets, galv., No. 28 ..	4.20
Sheets, blue an'l'd, 9 & 10	2.30
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv. ..	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry	—
„ furnace	—
Durham & North.	
„ foundry	—
„ furnace	42/6
Other Districts, foundry	—
„ „ furnace (basis)	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	25/-
„	28×20, „	50/-
„	20×10, „	—
„	18¾×14, „	—
C.W.	20×14, „	21/6
„	28×20, „	—
„	20×10, „	—
„	18¾×14, „	—

Terneplates 28×20, — per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£18/10 to £19/0
Rolled Ord.	£15/10/0 to £16
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£9 to £12
Pig-iron	£6 5 0 to £7 0 0

all f.o.b. Gothenburg.

TUBES AND FITTINGS.

Up to and incl. 6 in.

	Tubes	*Fittings*
Gas ..	60%	.. 50%
Water ..	55%	.. 45%
Steam ..	50%	.. 40%

W.I. 10% extra.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Aug. 5	59	0	0	dec. 5/-
„ 6	58	12	6	„ 7/6
„ 9	58	15	0	inc. 2/6
„ 10	59	0	0	„ 5/-
„ 11	58	15	0	dec. 5/-

Electrolytic Copper.

	£	s.	d.	
Aug. 5	67	0	0	dec. 5/-
„ 6	66	15	0	„ 5/-
„ 9	67	0	0	inc. 5/-
„ 10	67	0	0	No change
„ 11	67	0	0	„ „

Standard Tin (Cash).

	£	s.	d.	
Aug. 5	295	5	0	dec. 20/-
„ 6	296	5	0	inc. 20/-
„ 9	298	10	0	„ 45/-
„ 10	297	15	0	dec. 15/-
„ 11	294	0	0	„ 75/-

Tin (English ingots).

	£	s.	d.	
Aug. 5	293	15	0	dec. 20/-
„ 6	294	15	0	inc. 20/-
„ 9	297	0	0	„ 45/-
„ 10	296	5	0	dec. 15/-
„ 11	292	10	0	„ 75/-

Zinc Sheets (English).

	£	s.	d.	
Aug. 5	42	0	0	No change
„ 6	42	0	0	„ „
„ 9	42	0	0	„ „
„ 10	42	0	0	„ „
„ 11	42	0	0	„ „

Spelter (ordinary).

	£	s.	d.	
Aug. 5	34	5	0	inc. 5/-
„ 6	34	0	0	d.c. 5/-
„ 9	33	18	9	„ 1/3
„ 10	34	6	3	inc. 7/6
„ 11	34	6	3	No change

Lead (English).

	£	s.	d.	
Aug. 5	34	5	0	dec. 5/-
„ 6	33	15	0	„ 10/-
„ 9	34	0	0	inc. 5/-
„ 10	34	5	0	„ 5/-
„ 11	34	5	0	No change

AVERAGE MONTHLY PRICES OF CLEVELAND No. 3 PIG-IRON.

Year.	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Yearly Average.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d
1887	37 5	35 10	34 4	34 4	34 1	34 10	34 4	34 5	33 9	31 10	31 8	33 6	34 2
1888	32 2	31 1	31 5	31 9	30 11	31 5	32 4	33 5	34 8	34 2	33 11	33 10	32 7
1889	33 8	35 0	37 5	38 9	38 6	37 10	40 1	43 4	44 1	51 5	64 7	61 1	43 10
1890	60 3	53 1	51 0	47 4	42 2	41 5	43 2	45 7	47 9	47 10	47 4	43 1	47 6
1891	42 1	41 10	39 9	38 7	40 9	41 0	40 8	39 8	40 4	39 11	38 8	38 1	40 1
1892	37 7	35 7	36 10	37 10	39 2	40 11	39 11	39 10	40 0	38 6	37 6	37 4	38 5
1893	36 0	34 3	34 4	34 2	33 10	34 8	35 3	35 5	35 4	34 8	34 7	35 9	34 10
1894	35 8	35 11	36 1	36 1	35 5	35 5	35 5	35 11	36 6	35 8	35 8	35 1	35 9
1895	34 7	34 4	34 4	34 8	35 6	35 2	36 1	37 1	38 10	38 6	37 11	37 6	36 3
1896	37 3	38 4	38 7	38 1	37 4	37 4	36 11	36 11	37 11	39 2	40 5	40 5	38 3
1897	41 2	40 4	40 5	39 2	39 7	40 9	39 6	40 5	41 7	42 5	41 5	40 4	40 7
1898	40 9	40 8	40 6	40 0	40 7	39 11	40 4	41 11	43 0	44 11	49 1	44 3	42 0
1899	46 10	47 11	47 9	49 10	55 11	62 10	71 6	65 9	67 7	68 8	70 0	66 9	60 5
1900	67 10	68 10	73 10	76 2	74 2	68 6	69 3	71 4	70 9	67 8	63 6	53 6	68 9
1901	48 0	46 6	45 8	45 5	45 10	44 7	44 6	45 3	45 3	45 3	43 6	43 1	45 3
1902	43 11	46 7	46 9	47 11	48 10	49 7	50 9	52 1	53 6	52 9	50 9	47 11	49 3
1903	47 3	48 9	51 10	49 0	46 1	46 2	46 7	46 8	45 7	43 6	42 10	41 11	46 4
1904	42 3	42 7	43 3	44 7	44 0	42 10	42 9	43 3	43 1	43 9	46 1	48 7	43 11
1905	48 11	48 0	49 6	50 1	51 5	45 6	45 9	47 5	48 8	52 11	52 9	53 3	49 6
1906	53 9	50 1	48 1	48 8	50 2	50 3	50 6	53 0	54 6	56 8	58 6	62 4	53 0
1907	60 4	56 6	54 10	56 0	61 1	58 1	57 8	57 8	55 7	54 8	50 8	50 0	56 2
1908	48 5	49 3	51 7	51 10	51 6	51 2	50 0	51 4	52 0	49 8	49 4	48 11	50 8
1909	48 10	48 1	46 9	47 9	48 4	48 9	48 6	50 5	51 3	51 11	51 2	50 7	49 4
1910	51 10	51 3½	51 7½	50 10	49 10	49 2	48 10	49 8½	49 3½	49 7½	49 6½	49 10	50 4
1911	49 11½	49 2½	48 5	46 11	46 4	46 6	46 11½	47 4	47 0	46 7	4 4	48 1	47 7
1912	50 0	49 5½	51 1½	53 7½	54 4	55 1	57 5½	64 6½	61 7½	66 8½	67 8	68 0	58 5½
1913	66 11½	63 8½	64 8	67 1½	66 3	56 9½	56 3½	55 8	55 4	53 0	50 1	50 4	58 10
1914	50 11	51 5½	51 0½	51 4½	51 6	51 6½	51 5	52 3	51 5	50 1	50 3	53 0	51 4½
1915	55 7	56 6	61 0	66 7	65 2	66 10	65 4	66 0½	65 3	65 11	69 10½	75 7½	65 7½
1916	80 2	91 6	87 4½	86 10	82 6	82 6	87 6	87 6	87 6	87 6	87 6	87 6	85 10
1917	87 6	87 6	87 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	95 0	91 3
1918	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0
1919	95 0	95 0	95 0	95 0	152 6	160 0	160 0	160 0	160 0	160 0	160 0	160 0	137 8
1920	175 0	175 0	187 6	200 0	208 0	217 6	217 6	221 0	225 0	225 0	225 0	225 0	209 3
1921	222 6	195 0	150 0	126 0	120 0	120 0	120 0	136 3	127 0	120 0	110 0	100 0	137 4
1922	92 6	90 0	90 0	90 0	90 0	90 0	89 0	87 3	92 6	92 6	92 6	91 3½	90 7½
1923	94 6	108 9	125 6	129 4½	128 5	136 0	128 1½	121 11	97 1½	97 0	100 0	100 0	110 6½
1924	99 10	97 3½	91 9	93 9	91 9	89 10½	87 9	85 0	82 5½	80 2½	81 9	81 9	88 7½
1925	80 4½	78 10½	78 0	78 3	76 0	73 10½	71 7½	69 10½	68 1½	66 7½	66 0	66 10½	72 10½
1926	69 4½	70 0	70 0	70 0	72 6	75 10½	86 7½		—	—	—	—	73 5½

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NON-FERROUS METALS

COPPER, TIN. LEAD, SPELTER, ANTIMONY, CHROME ORE

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XUM

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SITUATIONS VACANT AND WANTED.

MANAGER of large American Cast Iron Sanitary Ware Factory intends locating in Great Britain, and is desirous of getting in touch with a firm who can utilise his services; thoroughly conversant with all modern processes for mass production.—Box 758, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOREMAN MOULDER (46) seeks. situation; 30 years' practical knowledge of foundry practice.—Address, Box "W. G. Y.," Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

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The Proprietors of the FOUNDRY TRADE JOURNAL have placed this space at the disposal of the British Legion, Officers' Association, Employment Bureau, 3-4, Clement's Inn, Strand, London, W.C.2. (telephone: Holborn 5769), to whom all replies should be addressed, quoting number of advertisement, date on which it appeared, and the name of this paper.

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AGENTS WANTED, all parts, calling on Foundries, to introduce patent Flux for Castings.—Write, CHAS. HALL, Ogdensburg, N.Y.

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MACHINERY, PLANT, &c.

TWO CORNISH BOILERS, 28 ft. x 6 ft. diam., reinsure 90 lbs. pressure.

COCHRAN VERTICAL BOILER, 7 ft. 8 in. high x 3 ft. 3 in. diam., reinsure 100 lbs. pressure.

HORIZONTAL STEAM-DRIVEN AIR COMPRESSOR, 14 in. steam cyl., 14 in. air cyl., 16 in. stroke, by American Well Works Co.

SENTINEL AIR COMPRESSOR, 260 cubic ft. capacity at 100 lbs. pressure, driven by 55 h.p. d.c. motor, 500 volts.

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CATALOGUE (10,000 LOTS) ON APPLICATION.

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SAND MIXERS.—New and second-hand. Ask us to quote.—W. BRADLEY & COMPANY, LIMITED, Prospect Works, Hawksley Avenue, Sheffield.

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PATENT.—The Proprietor of the British Patent No. 148,810, for a Sand Mill for Foundries and Steelworks, would Sell it on reasonable terms. The same invention is patented in Germany and the United States; great success in France.—Write to E. GERNELL, 15, Rue Tous Vents, Rouen, France.

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SETTLEMENT OF COAL STRIKE.—This may be a long way off yet, but the settlement of your **Foundry troubles** occasioned by the strike is within your reach. Send details of your difficulties to us and we will advise you how to get the best out of your present supplies of irons and coke.

Consultation on all problems undertaken by practical foundrymen and metallurgists. Terms moderate.

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BEECROFT AND PARTNERS, LTD.,
The Foundry Chemists,
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Telephone: 4908 Central.
Telegrams: "Retort, Sheffield."

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WANTED, "Foundry Trade Journal," October 16, 1924; February 4, March 11, 1926.—Reply to G. E. STECHERT & Co., 2, Star Yard, Carey Street, W.C.2.

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Wholesale and Shipping only

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Two Small MUMFORD plain Jolters, lift 4 cwt. - - - - - - - £12
42" × 36" heavy geared rumbling barrel - £28
36" × 24" rumbling barrel, new - - - £12
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All types and sizes of Fans sizes of Compressors kinds of Foundry Plant **in Stock**

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